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Adolescent childbirth and mobility disability among women ages 15-49: an analysis of population health surveys from 14 low- and middle-income countries

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TITLE: Adolescent childbirth and mobility disability among women ages 15-49: an analysis of population health surveys from 14 low- and middle-income countries

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ABSTRACT

Objectives: Adolescent childbirth is associated with older adult adverse health outcomes that negatively affect mobility function, but these associations have not been studied globally in large samples of reproductive-age women. This study examines the association between age at first childbirth and mobility disability in national surveys from low- and middle-income countries.

Methods: Population health surveys from 2013-2018 containing mobility disability measures among ever-pregnant women ages 15-49 were analyzed (14 countries) cross-sectionally. These included 13 Demographic Health Surveys (DHS) from Haiti, Pakistan, Uganda, Cambodia, Colombia, South Africa, Timor-Leste, Albania, Gambia, Maldives, Peru, Senegal, and Yemen and 1 Maternal Health Survey from Ghana. Covariates included current age, urban/rural residence, education, and household wealth. Poisson regression models were used to estimate prevalence ratios (PR) of mobility disability among women who first gave birth during adolescence (19 years or younger) and in adult life (ages 20 to 45 years) in each country and across the whole sample. Countries were also analyzed according to the use of standard and non-standard mobility disability measures.

Results: Prevalence of adolescent childbirth (17·5%-66·2%) and mobility disability (0·32%-21·45%) varied widely across countries. Adolescent childbirth was significantly ($p<0·05$) associated with greater mobility disability in 6 of 8 countries utilizing standard disability measures. Among the 6 countries that did not use standard disability measures, none showed a statistically significant association between adolescent childbirth and mobility disability. Considering the whole sample and adjusting for all covariates, women who gave birth during adolescence had greater prevalence of mobility disability (Pooled PR 1·19, 95%CI 1·06-1·31).

Conclusion: This analysis suggests a moderate and consistent association of adolescent childbearing with subsequent mobility disability. Adolescent childbearing appears to contribute to lasting negative effects on women's mobility.

Strengths and Limitations of This Study

- Examined a large sample (>100,000) of reproductive age women from diverse geographic settings across the globe
- Analysis based on *a priori* hypotheses guided by a strong theoretical framework
- Compared associations across different ways of measuring mobility disability
- Data for the outcome variable of mobility disability were self-reported. Previous research indicates that self-reported mobility disability often underestimates true prevalence.
- Cross-sectional nature of population health surveys prevented ascertainment of the timing of the onset of the mobility disability

ARTICLE SUMMARY

What is known on this topic

Women consistently experience higher prevalence of mobility disability compared to men across a diversity of cultural contexts, and this gap appears wider among populations from low- and middle-income countries (LMIC) compared to higher income settings. This suggests that sex- and/or gender-linked factors may contribute to a greater burden of disability among women. Women from LMIC tend to start childbearing earlier, and to date, only a few studies employing smaller, non-representative samples of women of reproductive and post-menopausal age have demonstrated an association between early childbearing age and mobility disability.

What this study adds

Results from this study suggest a moderate and consistent association of adolescent childbearing with mobility disability across diverse settings. To the best of our knowledge, no previous studies have been conducted examining the relationship between adolescent childbearing and mobility disability using reproductive age samples or nationally representative surveys of parous women. Moreover, the increased risk conferred by adolescent childbearing as examined in this study was both robust and consistent across different countries utilizing validated measures, indicating that this phenomenon is not context specific.

How this study might affect research, practice, or policy

These findings demonstrate the interconnectedness of childbirth and disability with implications across the lifespan and reinforce the need for integrated, preventive health policies targeting the critical period of adolescence. Differences in results between countries that did or did not utilize standard measures reinforce the importance of utilizing validated measures of disability in population surveys.

INTRODUCTION

Disability - the inability to perform specific social roles in day-to-day life due to health or physical problems, affects nearly 15% of the global population,[1] with 80% of the burden in low- and middle-income countries (LMIC).[2] While disability is highly prevalent, it is also difficult to measure and frequently underestimated, with limited comparable evidence globally.[1]

Adult-onset disability includes cognitive and mobility limitations, representing the end state of several impairment events leading to functional limitations and difficulties in daily activities.[3,4] Approximately 7% of individuals globally live with mobility disability,[1] a critical marker of wellbeing.[4] Mobility disability is a public health challenge, associated with declines in quality of life, and can contribute to substantial healthcare expenditures.[5] Moreover, mobility disability is associated with premature mortality and frequently results from changes to the immune, nervous, and endocrine systems initiated earlier in life.[5,6]

Globally, women tend to have higher prevalence of mobility disability compared to men, and this is more evident in LMIC.[7,8] To understand the greater burden of mobility disability among women, studies have demonstrated an association between reproductive history (parity and age at first birth) and outcomes that are highly correlated with disability, including low physical function measures,[9,10] but these studies have generally adopted smaller, non-representative samples of mostly peri- or postmenopausal women.

An estimated 18.5 million adolescent girls give birth every year in LMIC.[11] While it has been well established that adolescent fertility affects lifelong health[12] and has educational and economic[13,14] consequences for women and communities, few studies have sought to examine the relationship between adolescent childbearing and mobility disability.

Although there is evidence of the association between early childbirth and indicators of mobility disability among middle-aged[9] and older women,[10] this association has not been investigated among younger women. Such investigation may provide important data to inform reproductive health policies over the life-course.

In this study, we use 13 Demographic Health Surveys (DHS) and 1 Maternal Health Survey (Ghana) to study the association between adolescent versus adult childbirth and mobility disability among women of reproductive age (15-49 years) across 14 LMICs. Further, given few comparative studies on disability that include LMIC, and known underestimation of disabilities,[1] we also compare disability estimates, and measures of association, across the 14 countries.

METHODS

Data Sources and Procedures

All publicly-available national Demographic and Health Surveys (DHS), other DHS-related surveys, and Multiple Index Cluster Surveys (MICS) conducted between 2013-2018 were reviewed to identify measures of mobility disability among women of reproductive age. Surveys without disability measures were excluded. If a single country had multiple surveys between 2013 and 2018, only the most recent was analyzed. A total of 14 country-surveys had information on mobility disability and were included: 13 DHS (rounds VI and VII), and one Maternal Health Survey (Ghana, 2017).

The resulting sample included 157,988 women ages 15 to 49 years, with complete data on their age at first birth from 14 countries. The response rate for mobility disability questions among the sample population was greater than 99% in all surveys.

Measures

Exposure - Adolescent childbirth:
Adolescent childbirth was defined according to UN recommendations, ranging from 10 to 19 years of age.[11] Due to the implausibility of certain responses and to assure comparability across all surveys, we excluded from analysis women whose first childbirth was reported as 9 years or younger or older than 45 years (less than 1% of respondents). Our comparison group, adult childbirth, included those reporting their first birth between 20 and 45 years. The surveys

used self-reported 'age of respondent at first birth,' which was measured consistently with standard questionnaires across all countries.

Outcome - Disability:

In 2016, DHS adopted a standard disability module, with mobility disability assessed with a question widely used in observational studies. DHS uses the Washington Group on Disability Statistics validated Short Set on Functioning. It comprises six questions assessing six domains of disability: seeing, hearing, walking/climbing, remembering/concentrating, self-care, and communicating.[1,15] This scale has been used in previous global comparative studies and extensively field tested in a variety of settings.[1] As this analysis focuses on mobility, we examined the question specific to mobility impairment: "I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?"

Across surveys there was considerable diversity in the wording of the questions used to measure mobility disability (see Table S1; appendix A). Some surveys applied the standard disability module verbatim (Haiti, Pakistan, and Uganda). Others used a slightly modified version and/or were already using a version of the mobility question used in the Short Set on Functioning (Cambodia, Colombia, Ghana, South Africa, and Timor-Leste). We mapped the mobility disability assessment questions used across surveys to the standard module and stratified according to those that used the Short Set on Functioning question (or a similar version) and those using other assessments of mobility disability (see Table S1). We refer to surveys using the mobility disability question from the Short Section on Functioning as applying the standard disability question. Six surveys included unique and highly varied questions on disability and mobility (Albania, Gambia, Maldives, Peru, Senegal, and Yemen). All of these employed dichotomous response options of yes/no for indicating disability. To compare across all surveys, the responses 'some difficulty', 'a lot of difficulty', and 'cannot walk or climb steps at all' were classified as 'mobility disability' for the 8 countries using the standard disability question. We thus utilized a dichotomous mobility disability outcome for every country that was measured similarly for 8 standard surveys and distinctly for 6 non-standard surveys.

Explanatory Variables

Analyses in this study account for the effects of the following covariates: women's age in years at time of the survey, census-based definition of residence (urban/rural), educational attainment (no education, primary, secondary or more), and household wealth in quintiles. Covariates were selected on *a priori* evidence of potential confounding based on a life-course perspective relating adolescent exposures to adulthood health outcomes. Table S2 provides a description of each of these explanatory variables, along with why they were included in the analysis. Figure S1 depicts the hypothesized causal pathways by which adolescent childbirth could impact mobility disability later in life. Based on this figure, and corresponding directed acyclic graph, no statistical adjustment is required to estimate the total effect of adolescent childbirth on mobility disability, while adjustment for age, location of residence, education attainment, and household wealth is needed to estimate the direct effect.[16]

Statistical Analysis

All cross-sectional analyses were conducted using the survey sampling weights provided by the population-based surveys.[17] Descriptive statistics were performed to characterize the primary exposure and outcome measures. For each country, and for all countries combined, Poisson regression models were fit to estimate crude and adjusted prevalence ratios (PR) of mobility disability among women who first gave birth during adolescence compared to those who first gave birth as adults. All estimates were adjusted for the explanatory variables described above. Marginal predicted probabilities of mobility disability by age (between 15 and 49 years) for adolescent and adult first childbirth were estimated for each country and for all countries combined, applying standard survey weights.

A pooled estimate of the effect (prevalence ratio) was obtained by creating a dataset of adjusted survey estimates and performing a meta-analysis of the 14 surveys, by computing a weighted average of each countries' individual effect estimates. This was done for the full sample and for countries sub-grouped according to the use of the standard mobility question. Heterogeneity was assessed using the I^2 quantity for both the pooled sample of all countries and for the sub-groups. Analyses were conducted using STATA version 16 (STATA, College Station, TX, USA).

RESULTS

There was wide variation in respondent sociodemographic characteristics across surveys (Table 1). The mean age of respondents ranged from 29·6 (SD:10·5) in Colombia to 37·4 (SD:8·0) years in Albania. The percent of respondents living in rural areas ranged from 20·8 in Colombia to 84·7 in Cambodia, while those in the lowest economic quintile ranged from 17·2 in Peru to 21·4 in Yemen. The proportion of respondents who had not received formal education ranged from 1·0% in Albania to 63·7% in Senegal.

Table 1: Sociodemographic characteristics of female respondents who have ever given birth*, by country

	Survey type	Total ever given birth (n)	First birth between 10 and 19 years (n)	Mean age of respondent at interview, years (sd)		Rural residence (95% CI)			Lowest house-hold wealth quintile (95% CI)			No formal education (95% CI)		
Used Standard Disability Question**														
Cambodia, 2014	DHS-VI	11,722	4,053	34.2	(8.2)	84.7%	(81.6%	- 87.5%)	20.5%	(18.1%	- 23.2%)	16.3%	(14.7%	- 18.0%)
Colombia, 2015	DHS-VII	25,446	13,222	29.6	(10.5)	20.8%	(19.4%	- 22.3%)	20.5%	(18.5%	- 22.6%)	1.3%	(1.1%	- 1.5%)
Ghana, 2017	MHS	14,385	7,412	33.5	(8.6)	51.2%	(47.5%	- 55.0%)	17.6%	(15.8%	- 19.6%)	28.1%	(26.3%	- 30.0%)
Haiti, 2016	DHS-VII	8,607	3,816	33.5	(8.5)	57.2%	(51.5%	- 62.7%)	20.4%	(17.6%	- 23.5%)	21.1%	(19.2%	- 23.1%)
Pakistan, 2017-18	DHS-VII	13,118	5,165	33.4	(8.0)	66.4%	(61.7%	- 70.9%)	19.5%	(16.9%	- 22.5%)	49.2%	(45.9%	- 52.4%)
South Africa, 2016	DHS-VII	6,111	2,871	33.6	(8.4)	33.2%	(29.1%	- 37.5%)	17.5%	(15.1%	- 20.1%)	2.3%	(1.8%	- 2.9%)
Timor Leste, 2016	DHS-VII	7,470	2,359	34.1	(8.3)	72.6%	(67.2%	- 77.5%)	20.4%	(18.3%	- 22.6%)	29.9%	(27.5%	- 32.2%)
Uganda, 2016	DHS-VII	13,744	9,197	31.2	(8.5)	75.1%	(71.2%	- 78.7%)	20.7%	(18.6%	- 22.9%)	12.3%	(11.3%	- 13.4%)
Did Not Use Standard Disability Question														
Albania, 2017-18	DHS-VII	7,226	1,316	37.4	(8.0)	42.5%	(38.2%	- 46.9%)	20.3%	(17.4%	- 23.3%)	1.0%	(0.6%	- 1.7%)
Gambia, 2013***	DHS-VI	6,845	4,113	31.2	(8.1)	48.2%	(41.1%	- 55.4%)	20.3%	(17.0%	- 24.0%)	60.0%	(57.0%	- 62.9%)
Maldives, 2016-17	DHS-VII	5,408	1,569	35.1	(7.6)	61.1%	(53.8%	- 68.0%)	20.1%	(17.9%	- 22.4%)	6.0%	(5.2%	- 7.0%)
Peru, 2014***	DHS-VI	17,487	8,237	34.9	(8.4)	26.0%	(23.9%	- 28.1%)	17.2%	(15.9%	- 18.7%)	2.9%	(2.5%	- 3.3%)
Senegal, 2014	DHS-VI	5,733	3,180	32.2	(8.5)	51.1%	(41.0%	- 61.2%)	20.2%	(15.0%	- 26.1%)	63.7%	(58.2%	- 69.0%)
Yemen, 2013	DHS-VI	14,686	8,127	31.8	(8.1)	67.4%	(63.2%	- 71.5%)	21.4%	(19.0%	- 23.9%)	55.1%	(52.8%	- 57.4%)

*For women who had ever given birth who completed the question on mobility disability

**Countries that utilized the disability module developed through collaboration including USAID, Demographic and Health Surveys Program, and the Washington Group on Disability Statistics and/or mapped to this module with very similar questions. See "Demographic and Health Surveys Disability Module, Model Household Questionnaire," https://dhsprogram.com/pubs/pdf/DHSQM/DHS7-Module-Disability-Qnnaire-EN-31Jan2017-DHSQM.pdf.

***These datasets contained a single composite wealth index variable categorized into quintiles using national cut-off points for all areas. In all other countries wealth quintile classification is derived from wealth index scores that use separate cut-off points for rural and urban residences. A wealth variable (V190A) with rural and urban cut-off points was developed by DHS and included in the databases for Albania, Colombia, Ghana, Haiti, Maldives, Pakistan, Peru, South Africa, Timor-Leste, and Uganda. Our team created the wealth index variable in quintiles for Cambodia, Senegal, Gambia and Yemen from the DHS created cut-off points for urban and rural wealth quintile included in the publicly available datasets.

The prevalence of adolescent childbearing (ages 10-19 years) ranged between 17·5% in Albania in to 66·2% in Uganda (Table 2). In five (Ghana, Uganda, Gambia, Senegal and Yemen) of the 14 countries, more than 50% of women had their first birth at 19 or younger. Mobility disability ranged between 0·3% in Peru to 21·5% in Ghana. Mobility disability prevalence was higher among countries using the standard disability question (range 1·5-21·5%) compared to those using non-standard measures (0·3-1·2%) (Table 2).

Table 2: Prevalence of adolescent childbearing and mobility disability in female respondents who have ever given birth, by country

	Prevalence of adolescent childbearing (10 to 19 years) (95% CI)			Prevalence of first birth between ages 20 and 45 years (95% CI)			Prevalence of mobility disability (95% CI)		
Used Standard Disability Question									
Cambodia, 2014	34.8%	(33.5%	- 36.1%)	65.2%	(63.9%	- 66.5%)	1.52%	(1.1%	- 2.0%)
Colombia, 2015	47.2%	(46.0%	- 48.4%)	52.8%	(51.6%	- 54.0%)	3.97%	(3.7%	- 4.3%)
Ghana, 2017	52.1%	(50.7%	- 53.5%)	47.9%	(46.5%	- 49.3%)	21.45%	(20.3%	- 22.6%)
Haiti, 2016	43.0%	(41.4%	- 44.7%)	57.0%	(55.3%	- 58.6%)	3.02%	(2.5%	- 3.7%)
Pakistan, 2017-18	36.7%	(34.9%	- 38.5%)	63.3%	(61.5%	- 65.1%)	10.31%	(9.3%	- 11.4%)
South Africa, 2016	46.4%	(44.5%	- 48.2%)	53.6%	(51.8%	- 55.5%)	3.82%	(3.2%	- 4.5%)
Timor-Leste, 2016	31.5%	(30.0%	- 33.1%)	68.5%	(66.9%	- 70.0%)	2.32%	(1.9%	- 2.8%)
Uganda, 2016	66.2%	(64.8%	- 67.5%)	33.8%	(32.5%	- 35.2%)	9.37%	(8.7%	- 10.1%)
Did Not Use Standard Disability Question									
Albania, 2017-18	17.5%	(16.3%	- 18.9%)	82.5%	(81.1%	- 83.7%)	0.97%	(0.7%	- 1.3%)
Gambia, 2013	58.5%	(56.6%	- 60.3%)	41.5%	(39.7%	- 43.4%)	1.24%	(0.9%	- 1.7%)
Maldives, 2016-17	27.1%	(25.2%	- 29.0%)	72.9%	(71.0%	- 74.8%)	0.46%	(0.3%	- 0.7%)
Peru, 2014	43.2%	(42.0%	- 44.5%)	56.8%	(55.5%	- 58.0%)	0.32%	(0.2%	- 0.5%)
Senegal, 2014	50.1%	(46.4%	- 53.8%)	49.9%	(46.2%	- 53.6%)	0.60%	(0.4%	- 0.9%)
Yemen, 2013	56.1%	(54.8%	- 57.4%)	43.9%	(42.6%	- 45.2%)	0.45%	(0.3%	- 0.6%)

Figure 1 shows the crude and adjusted associations between adolescent childbirth and mobility disability, stratified by use of the standard disability question. Among the eight countries that utilized the standard disability question, the unadjusted PR ranged between 0·99 (95% CI:0·84-

1·15) in Colombia and 1·43 (95% CI:1·04-1·97) in South Africa and the adjusted PR ranged from 1·11 (95% CI:0·98-1·26) in Uganda to 1·50 (95% CI:1·10-2·05) in Timor Leste. Adolescent childbirth was associated with greater mobility disability in three of the eight countries before adjustment, and in six of the eight countries after adjustment. Among the six countries that did not use the standard mobility disability question, no association between adolescent childbirth and mobility disability was observed. Table S3 provides the crude and adjusted PRs by country.

Figure 1: Unadjusted (black diamonds) and adjusted (blue squares) associations between adolescent childbirth and mobility disability, stratified by use of Standard Disability Question in 14 countries

Note: for each country, the first row indicates the crude PR, and the second row indicates the adjusted PR.

Based on the pooled adjusted estimate for all 14 countries, women who gave birth during adolescence had an increased prevalence of mobility disability (Overall PR 1·19, 95%CI:1·06-1·31) compared to women who first gave birth between 20 and 45 (Figure 1). The pooled PR for countries using the standard question was 1·25 (95%CI 1·16-1·34), compared to 1·10 (95%CI 0·83-1·37) for countries using non-standard questions. Results indicate low heterogeneity, i.e., variability not attributable to chance, when examining all countries together (I^2 = 15·0%, p=0·24). There was, however, evidence of moderate heterogeneity based on the sub-group analysis, specifically for the countries that used the standard mobility questions (I^2 =59%, p=0·001). Nevertheless, the effect estimates were consistent across studies using the standard disability question (i.e., indicated by the positive associations) and confidence intervals were relatively narrow.

Figure 2 shows the predicted prevalence of mobility disability by age at time of interview for women who had a first birth during adolescence compared to adulthood. Estimates are based on the marginal prediction of mobility disability by age from the adjusted Poisson regression models including all eight countries that used the standard disability question. Across all ages, prevalence of mobility disability was higher for women who had their first birth during adolescence compared to those who had their first birth later, with an increasing gap between both groups with increasing age. Combined results for all 14 countries showed similar trends

(see Figure S2). Figure S3 provides the results for the countries that used non-standard measures of mobility disability.

Figure 2: Pooled prevalence (marginal predictions) of mobility disability comparing women with first birth during adolescence and first birth in adulthood based on countries that used standard Disability Question (n=8).

The supplementary files (Figures S4 and S5) also show the predicted prevalence of mobility disability by adolescent versus adult first childbirth by each country, stratified by those using the standard disability question (Figure S4) versus other measures of mobility disability (Figure S5).

DISCUSSION

Summary of Results

Both the prevalence of adolescent childbirth and mobility disability varied widely across countries. Adolescent childbirth was consistently and significantly associated with greater mobility disability in six of the eight countries that utilized the standard disability question. In the pooled analysis of the 14 countries, women who had their first birth during adolescence continued to have significantly higher prevalence of mobility disability throughout life compared to women who had their first birth as adults.

Comparison with Existing Studies

To our knowledge, no study has been conducted examining the relationship between adolescent childbearing and mobility disability using reproductive age samples or nationally representative surveys of parous women. The focus on mobility disability was based on previous work demonstrating associations between early childbirth and loss of physical performance, as measured by objective tests of lower limb function.[9,10] Physical performance tests assess functional limitations that contribute significantly to mobility disability.[5]

Our data presents an overview of LMICs from diverse global regions. The percentage of women who first gave birth between ages 10 and 19 years was lowest in Albania and highest in Uganda, which generally ascribed to what is known about the relative regional prevalence of childbearing.[18] While rates of adolescent childbirth among those who have given birth in several African countries were higher than current estimates suggest,[18] the adolescent pregnancy rate has declined over time across most regions, so the prevalence for women born in earlier cohorts (currently in their later reproductive years) is higher than the prevalence in more recent cohorts.[19]

The measurement of mobility disability has historically been challenging and remains relatively understudied in LMIC.[2] Variability in the prevalence of mobility disability was previously documented in the 59 countries included in the 2004 WHO World Health Survey, where the average disability prevalence was 15·6%, ranging from 11·8% in high-income countries to 18·0% in low-income countries. Prevalence is known to be higher among the poor.[1] More recent comparative global studies are largely lacking.

To quantify the health burden associated with adolescent fertility, others studies have examined years of healthy life lost due to adverse pregnancy and childbirth outcomes.[20] While, to our knowledge, no one has studied adolescent childbearing and mobility disability using large datasets, previous associations with years of healthy life lost hint at the possibility of an association between adolescent childbirth and adult-onset disability. Adolescent mothers are prone to adverse pregnancy and childbirth events that affect quality of life.[11,20] Complications related to pregnancy and childbirth are a leading cause of death and disability (including anemia, incontinence, damage to the reproductive system, chronic pain, and infertility) among women of reproductive age in low-income countries.[21] However, studies tend to focus on the direct health effects of obstetric complications, which are not the only factors that could contribute to mobility disability. A recent systematic review of adolescent childbearing and cardiovascular disease (CVD) suggested the former as an important cause of disability, especially with advancing age.[12]

Interpretation of Findings

Overall, our results provide important evidence of a population-wide association between adolescent childbearing and mobility disability. Of interest is that the eight countries that utilized the standard disability question produced much more precise estimates of both prevalence of disability and its association with adolescent pregnancy, and had generally larger effect sizes than the countries using other questions.

For the six countries that used non-standard questions, the estimates were less precise, and associations with adolescent childbirth were unobserved. The prevalence of mobility disability was also consistently lower than would be expected based on the most recent available WHO estimates of disability.[1] Two surveys, Albania and Maldives, asked respondents to directly identify what long-term disability they have. This highlights the importance of using standardized, validated measures of disability. It is assumed that the validated disability module would provide higher quality data, as the questions ask whether people can perform activities of daily living, as opposed to asking individuals to self-identify as disabled, which is a potentially stigmatizing label. The Washington Disability Group (2017) explicitly advises against using the word disability in questionnaires or interviews to avoid casting the questions in a negative light and due to the variability about how a term is understood between and within populations. Non-standardized and non-validated questions also allow for a variety of interpretations related to self-perceptions of physical ability, that can compromise data on the true prevalence of disability.

While mobility disability is often a condition associated with aging, our results suggest that mobility declines are emerging in early to middle adulthood for some women. The fact that this observation was relatively consistent across different countries indicates that this phenomenon is not context-specific.

Our results are also suggestive of earlier initiation of the disablement process among women who first gave birth during adolescence. These women will likely live longer with mobility problems, which may negatively impact their quality of life and increase individual and government healt-related costs. It is also well recognized that disability, especially in LMIC, contributes to premature mortality.[6] Given research to indicate reduced longevity for adolescent mothers,[22,23] our findings of an association with mobility disability may point to one mechanism underlying premature mortality for adolescent mothers.

Mobility disability may emerge as an amplified physical manifestation of the socio-economic disadvantages that may precede and/or be accelerated by adolescent childbirth. Early childbirth may initiate a cascade of social and biological changes that impact health over the lifespan. These may stem from physical injury resulting from the birth process as an adolescent, who tend to experience more obstetrical complications,[21] as well as the physical effects of a higher number of pregnancies, and/or mistimed or poorly spaced pregnancies that could be more likely when childbearing happens earlier.[11,20]

Methodological Considerations

All our estimates are based on self-reported data, and perceptions of disability are context dependent. Self-reported rates of disability are often lower than those estimated through objective measures of function, such as grip strength, walking speed, or time needed to rise from a chair.[24] Thus, mobility disability is likely underestimated among respondents in these surveys, especially in countries using non-validated measures of mobility disability.

The DHS provides novel opportunities for comparative analysis of disability across diverse contexts, including in low-resource countries where other sources of information regarding disability are unavailable. Because of the wide range of questions asked of DHS respondents, we could adjust for a number of explanatory variables identified in literature as potential confounders in the relationship between age of childbirth and mobility disability: age,[25] location of residence,[26] education,[27-29] and wealth quintile.[28-30] This is a strength of our analyses.

As DHS surveys are cross-sectional, we cannot know conclusively whether the disabilities reported were present at birth, developed during infancy, or were adult-onset. While it is possible that there is some misclassification in the outcome measure, it is unlikely that these misclassified cases are more common among those who had their first birth during adolescence, thus, biasing our results.

The surveys also have limitations around the reproductive and social history information that could be relevant to the analysis. Data on adolescent pregnancies that did not end in a live birth were not collected, which may correspond to many pregnancies among adolescents.[31] Past experiences of childhood violence were also not consistently measured across the data sets and may represent a confounder that was unaccounted for in our analysis. Parity was not included in the analysis as it is on the causal pathway between adolescent childbirth and disability; women who begin their childbearing years earlier tend to have more children.[9] Therefore, adjusting for parity leads to an overadjustment obscuring real associations. Finally, as this analysis only included parous women, our findings may not be generalizable to women who did not or could not give birth.

CONCLUSION

Results from this study of reproductive-age women across diverse global contexts is concordant with previous research in higher income settings and in older populations. The results provide new evidence of the long-term disabilities associated with adolescent childbirth in LMICs. Our results also suggest that the negative effects of adolescent childbearing may have their onset in early to middle adulthood instead of only later in life.

These findings reinforce the need for preventive health policies targeting the critical period of adolescence, including availability of sexual and reproductive health education and access to services and contraceptives, as well as health and social supports for adolescent mothers, with the goal of maintaining health across the life course.

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COMPETING INTERESTS

The authors declare no competing interests.

FUNDING

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DATA SHARING

Data and data dictionary are publicly available by request at https://dhsprogram.com/. Statistical code can be provided upon request to the corresponding author.

CONTRIBUTORS

KEP, DGB, and CMP: conceptualized the study, developed the analytical strategy, did the statistical analysis, interpreted the results, and wrote the first draft of the report.
SMAC and MPV contributed to the study conceptualization and analytical framework.
SMAC, MRD, TLS, and MPV: contributed to the interpretation of the results and did the critical revisions. KEP, DGB, and CMP: verified the underlying data.

PATIENT AND PUBLIC INVOLVEMENT

This paper analyzes existing, public data from population surveys conducted from 2013-2018. No patients were involved, as this is secondary data analysis and the surveys did not involve people receiving clinical care. The public was not involved in the design or conduct of the study. If published, we intend to disseminate widely to reach a broad audience.

ETHICS STATEMENT

This research consisted of a secondary data analysis of a public dataset in which respondents were not individually identifiable. Analysis does not involve research with human subjects and did not require review by an ethics committee/Institutional Review Board.

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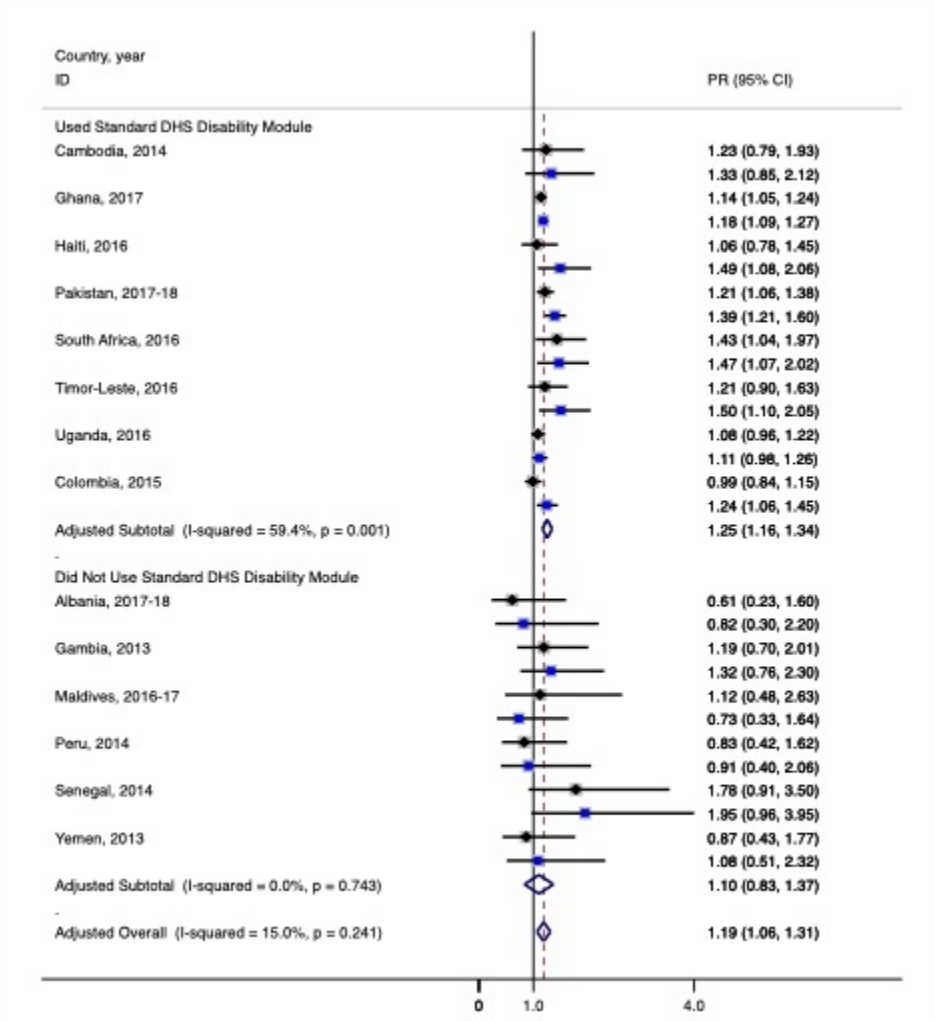

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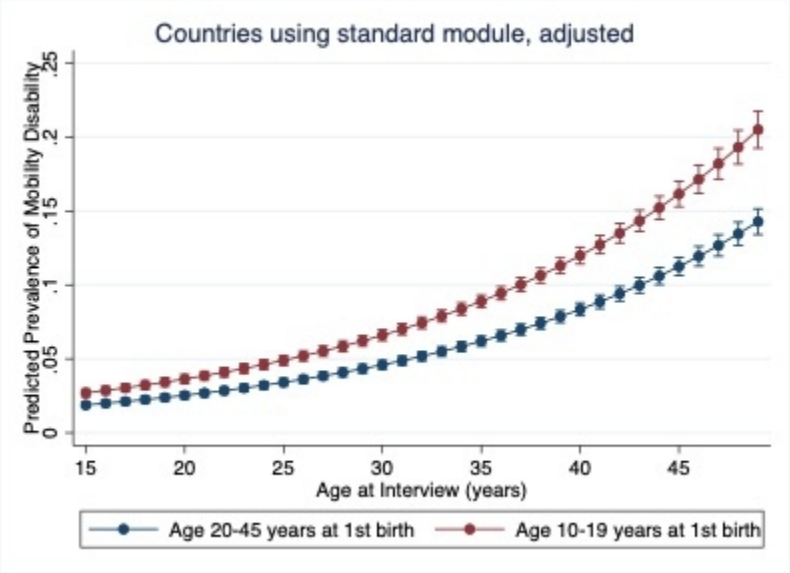

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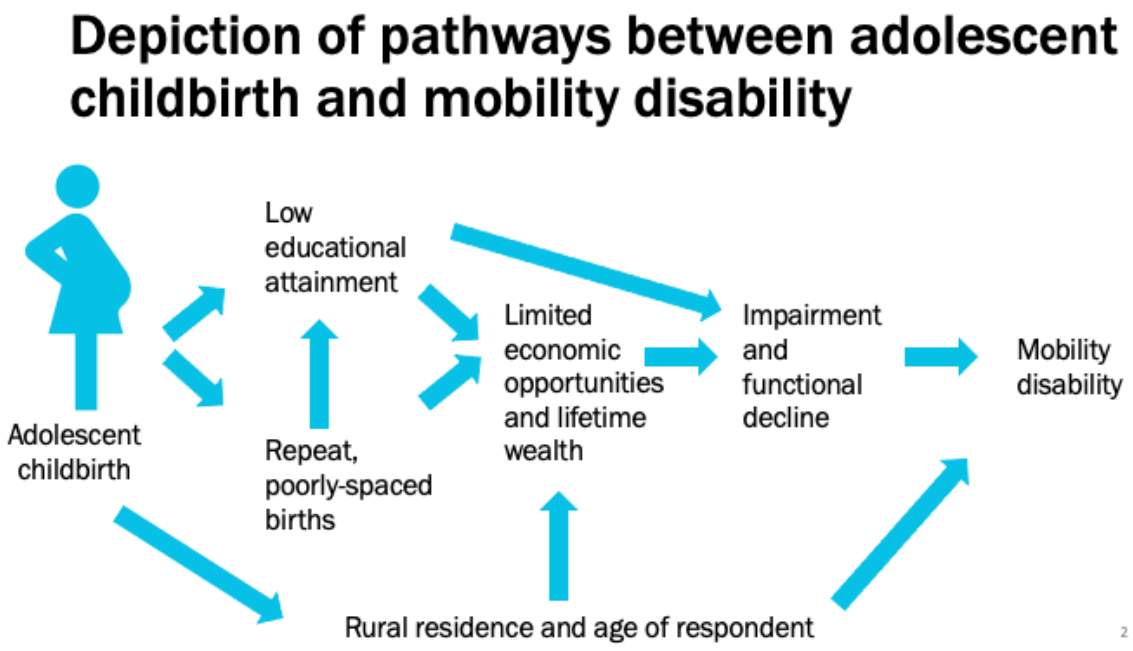

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Figure S2: Pooled prevalence (marginal predictions) of mobility disability comparing women with first childbirth during adolescence and first birth in adulthood based in all countries (n=14).

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.

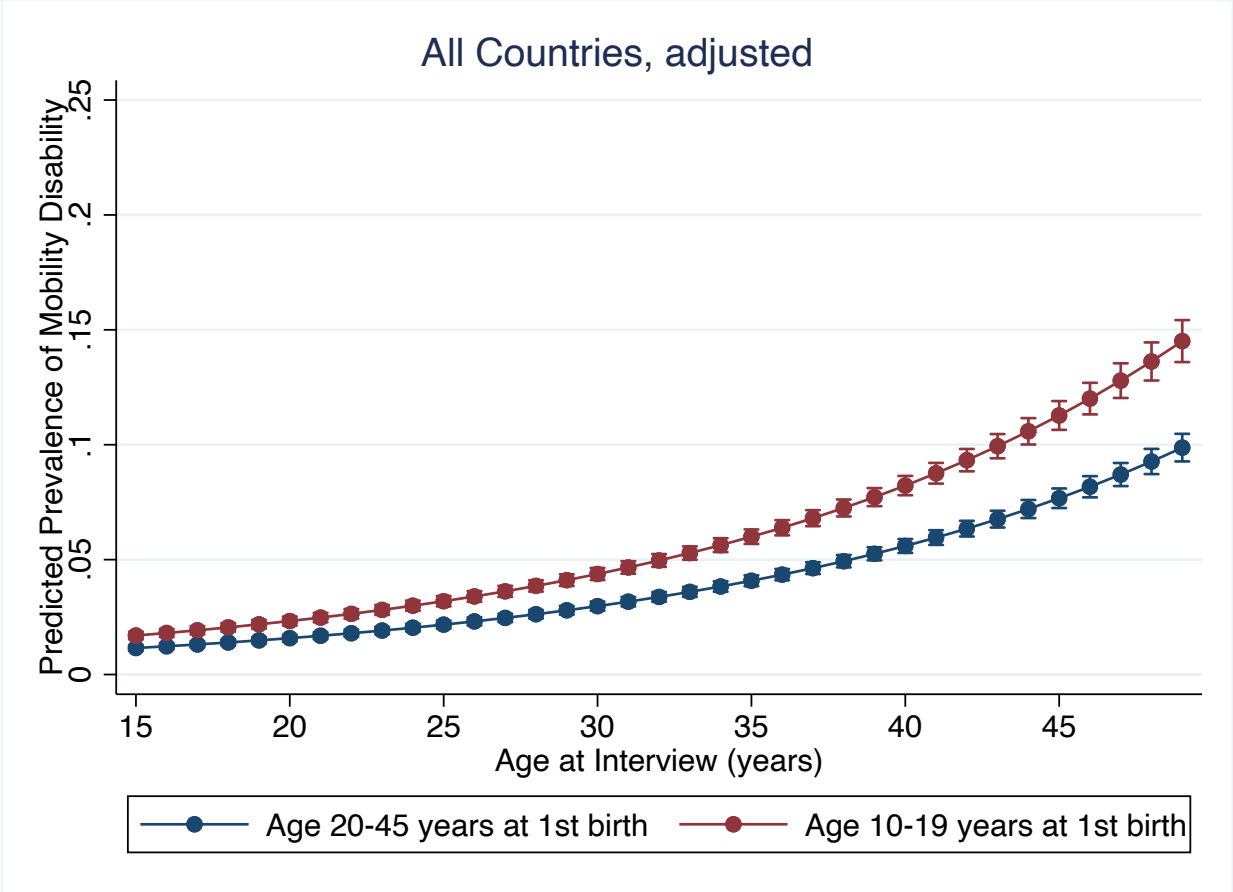

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Figure S3: Pooled prevalence (marginal predictions) of mobility disability comparing women with first childbirth during adolescence and first birth in adulthood based on countries that used non-standard measures (n=6).

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.

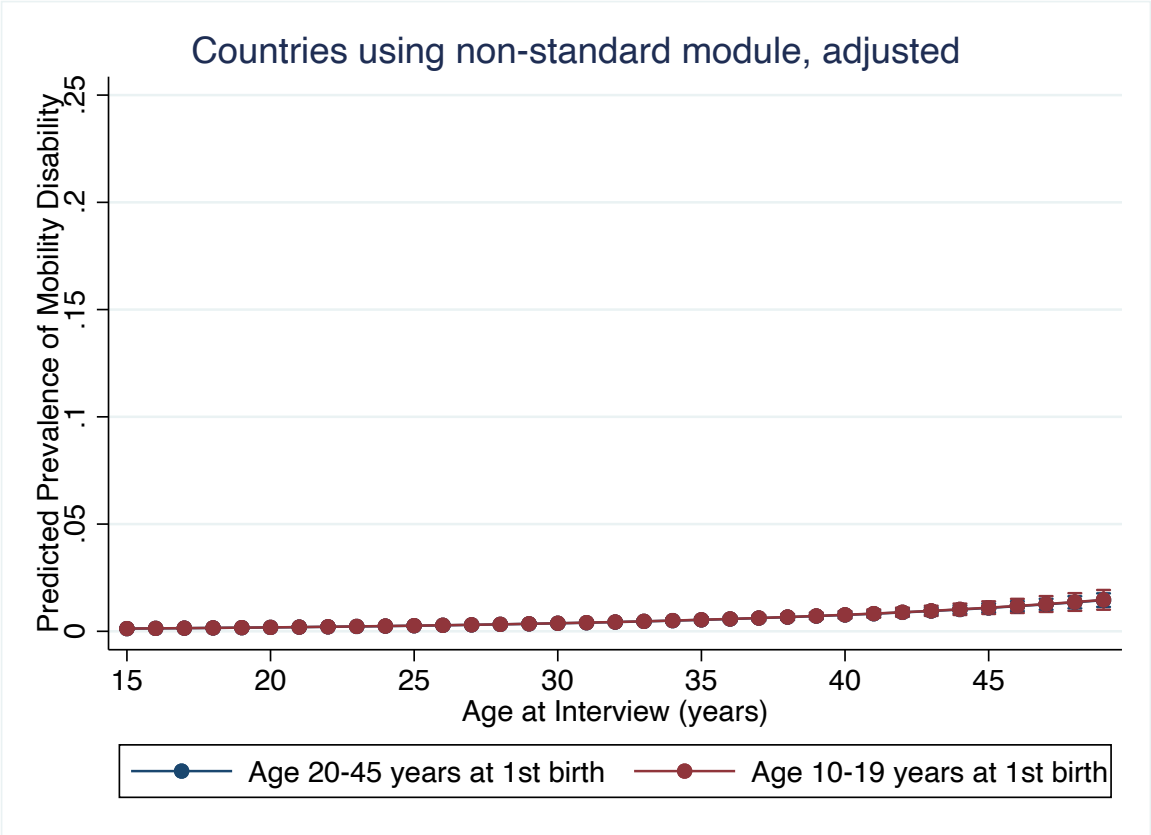

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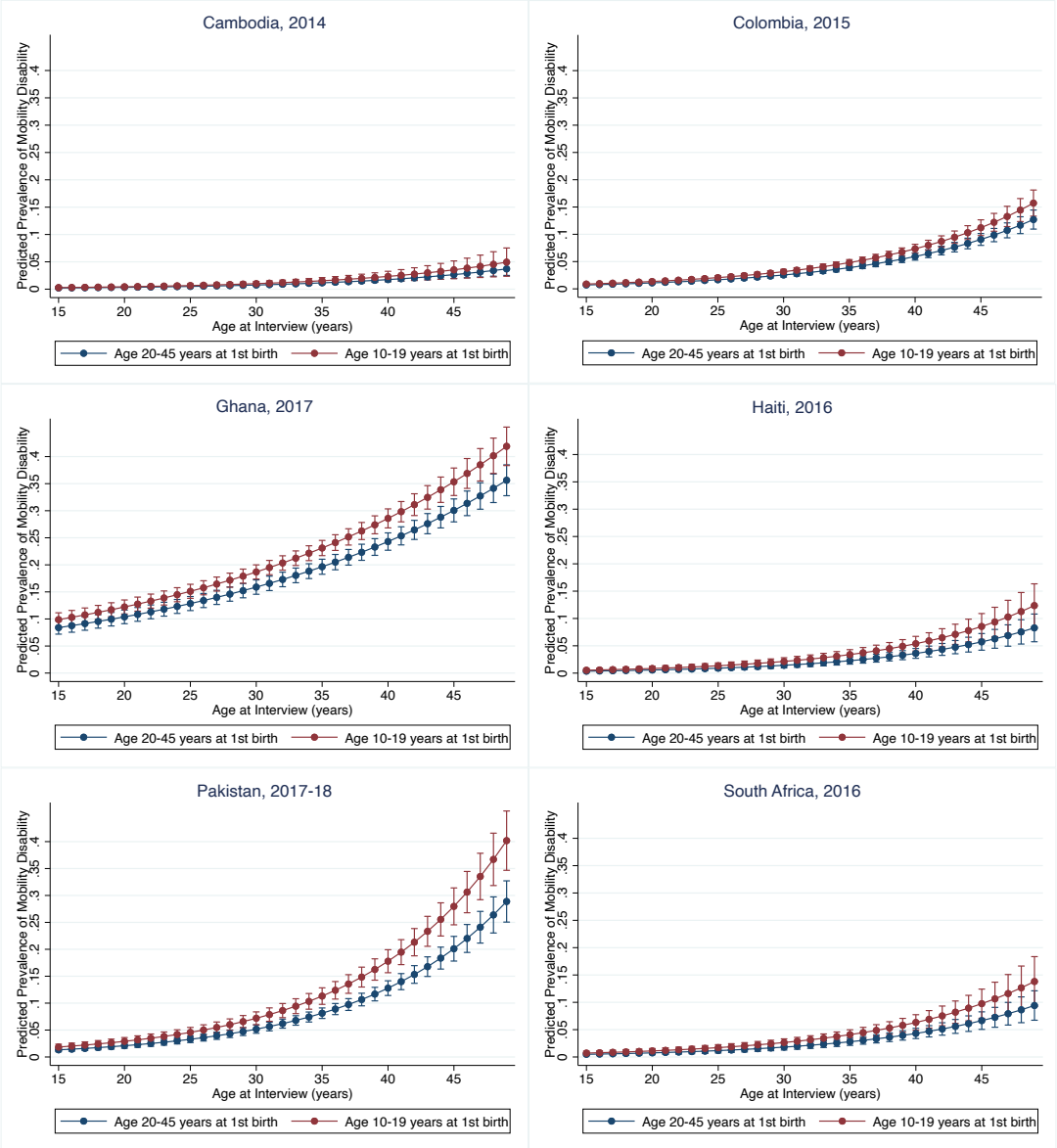
Figure S4: Predicted prevalence of mobility disability comparing women with first childbirth during adolescence and first childbirth in adulthood, by country, among those using the standard disability question.

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.



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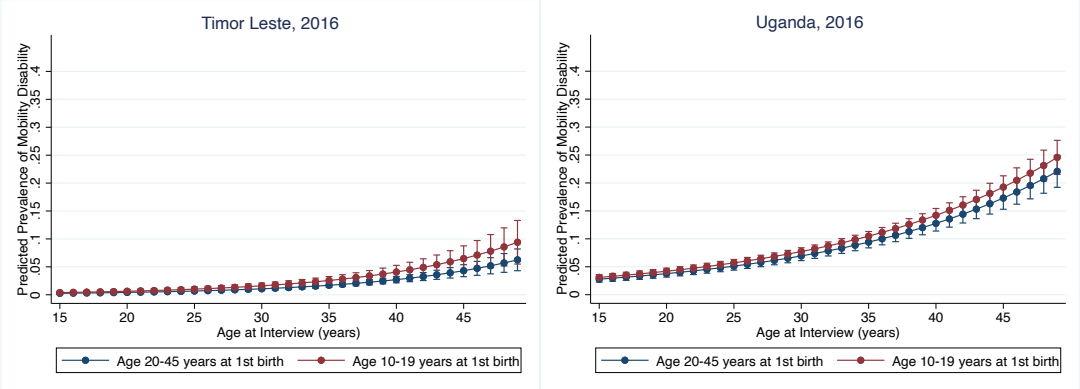

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Figure S5: Predicted prevalence of mobility disability comparing women with first childbirth during adolescence and first childbirth in adulthood, by country, among those using non-standard disability measures

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.

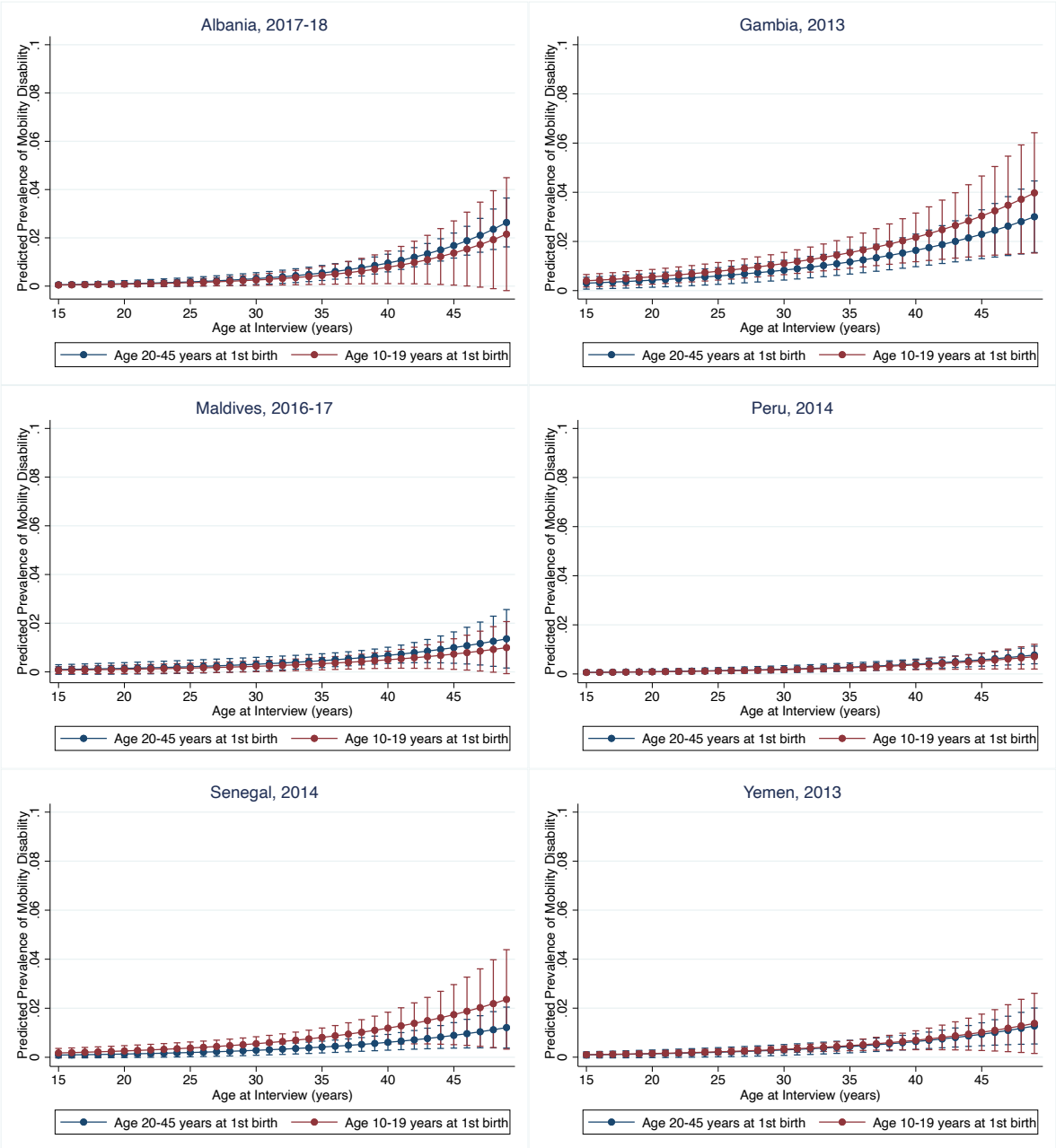

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Table S1: Mobility disability questions and response options for the countries included in the analysis.

Country	Question	Response Options Indicating Mobility Disability
Countries/surveys Using the Short Set on Functioning Disability Mobility Question		
Cambodia, 2014	23: Does [NAME] have difficulty walking or climbing steps?	2=With some difficulty 3=With a lot of difficulty 4=Cannot walk or climb stairs at all
Colombia, 2015	53. The following questions are about the ability of people to perform daily activities, without help or assistance. Would you say given their physical and mental condition, can [NAME] move their body, walk, or go up or down stairs?	1=Cannot do it 2=Can do it with a lot of difficulty 3=Can do it with some difficulty
Ghana, 2017	923: I would like to know if you have difficulty walking or climbing steps. Would you say that you have no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulty 3=A lot of difficulty 4=Cannot at all
Haiti, 2016	34: I would like to know if (name) has difficulty walking or climbing steps. Would you say that (name) have no difficulty walking or climbing steps, some difficulties, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulties 3=A lot of difficulties 4=Cannot walk or climb at all
Pakistan, 2017-18	33: I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulty 3=A lot of difficulty 4=Cannot walk or climb at all
South Africa, 2016	22: Does (NAME) have difficulty walking a kilometre or climbing a flight of steps? IF YES, PROBE: With some difficulty, with a lot of difficulty, or cannot walk or climb steps at all?	1=With some difficulty 2=With a lot of difficulty 3=Cannot walk or climb at all

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Timor-Leste, 2016	27: Does (NAME) have any difficulty walking or climbing steps?	2=Some difficulty 3=A lot of difficulty 4=Can't walk at all
Uganda, 2016	31: I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=With some difficulty 3=With a lot of difficulty 4=Cannot walk or climb at all
Countries/surveys Not Using Alternative Mobility Disability Questions		
Albania, 2017-18	1106: What type of chronic disability do you have?	D=Mobility problems
Gambia, 2013	27: Does (NAME) have any difficulty using his / her legs even for simple activities such as walking or climbing up the stairs?	1=Yes
Maldives, 2016-17	27: What type of disability does (NAME) have?	07=Medical disability
Peru, 2014	26: Does (NAME) have any limitation or permanent disability?	1=To move around, walk, using arms or legs
Senegal, 2014	31: Does (NAME) have a reduction or weakness in the following functions: CIRCLE ALL THE MENTIONED FUNCTIONS A=SIGHT B=HEARING C= COMPREHENSION & COMMUNICATION D=MOBILITY E=SELF-CARE F=INTERACTION WITH PEOPLE 32: WHAT IS THE PRINCIPAL CAUSE OF THE DISABILITY OF (NAME)?	D=Mobility
Yemen, 2013	32: Does (NAME) face limitations of any of the following: A = SIGHT? B = HEARING? C = COMPREHENSION & COMMUNICATION? D = MOBILITY? E = SELF-CARE? F = DEALING WITH PEOPLE?	D=Mobility

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Table S2: Explanatory Variables of Relevance to the Analysis

Variable	DHS Measure	Potential for Confounding	Consistently Measured Across DHS?
Age	All surveys asked respondents their month and year of birth, as well as their age at their last birthday. In cases of discrepancy, survey administrators were encouraged to correct the inconsistencies. Age was reported in years.	Chronological age and disability are positively associated.[1]	Yes
Location of Residence	Across the surveys, residence was consistently recorded as urban or rural.	Disability is reported at higher rates in rural than urban settings.[2] Location of residence also relates to other factors of interest, such as education and wealth.	Yes
Education	12 of the 14 surveys asked respondents to report their highest year of schooling as none, primary, secondary, or higher, while 2 of the 14 surveys (Ghana and Yemen) contained unique response options.	Educational attainment is consistently and negatively associated with mobility disability, especially with increasing chronological age.[3,4] It is also negatively associated with adolescent childbirth.[5]	To harmonize across surveys, educational attainment was re-coded across the countries as none, primary, or secondary or higher.
Wealth Quintile	All surveys collected standardized information on a respondent's household assets. DHS utilizes a standardized recoding of these assets across surveys in order to create the wealth index, a composite measure of a respondent's household standard of living (ICF, 2018). The wealth index is then separated into quintiles, with Q1 representing the poorest 20 percent of householders and Q5 the richest 20 percent of households.	Economic factors, including limited income, are associated with frailty among older adults.[3,4,6] It has also been established that there is a strong correlation between poverty and disability in LMICs.[7]	For purposes of harmonizing the datasets, we coded a wealth index variable in quintiles from the DHS-created cut-off points for urban and rural wealth quintile included in the publicly available datasets.

Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Table S3: Crude and adjusted associations between adolescent childbirth and mobility disability, by country

Note: Bold font indicates statistically significant associations at a p-value of 0.05 or less.

	Crude PR (95% CI) p-value	Adjusted PR (95% CI) p-value				
		Age	Residence	Education	Wealth Quintile	**All co-variates**
Albania, 2017-18	0.61(0.23-1.60) 0.31	0.84(0.31-2.29) 0.74	0.60(0.23-1.57) 0.29	0.57(0.22-1.48) 0.25	0.57(0.22-1.51) 0.26	0.82(0.30-2.20) 0.69
Cambodia, 2014	1.23(0.79-1.93) 0.36	1.36(0.87-2.13) 0.18	1.22(0.78-1.90) 0.38	1.19(0.76-1.89) 0.45	1.23(0.78-1.95) 0.37	1.33(0.84-2.12) 0.23
Gambia, 2013	1.19(0.70-2.01) 0.53	1.25(0.73-2.14) 0.41	1.23(0.72-2.11) 0.45	1.17(0.68-2.00) 0.57	1.22(0.72-2.10) 0.46	1.32(0.76-2.30) 0.32
Ghana, 2017	**1.14(1.05-1.24) 0.00**	**1.23(1.14-1.33) <0.001**	**1.13(1.05-1.23) <0.001**	**1.09(1.01-1.18) 0.04**	**1.11(1.02-1.20) 0.01**	**1.18(1.09-1.27) <0.001**
Haiti, 2016	1.06(0.78-1.45) 0.70	1.34(0.99-1.82) 0.06	1.09(0.79-1.51) 0.58	1.03(0.75-1.44) 0.84	1.07(0.79-1.45) 0.66	**1.49(1.08-2.06) 0.02**
Maldives, 2016-17	1.12(0.48-2.63) 0.79	0.83(0.37-1.85) 0.64	1.05(0.46-2.39) 0.90	0.81(0.37-1.79) 0.60	0.96(0.40-2.36) 0.94	0.73(0.33-1.64) 0.45
Pakistan, 2017-18	**1.21(1.06-1.38) 0.01**	**1.37(1.19-1.57) <0.001**	**1.24(1.08-1.41) <0.001**	1.14(1.00-1.31) 0.06	**1.21(1.05-1.39) 0.01**	**1.39(1.21-1.60) <0.001**
Peru, 2014	0.83(0.42-1.62) 0.59	1.01(0.50-2.04) 0.98	0.85(0.44-1.67) 0.65	0.73(0.36-1.47) 0.37	0.84(0.37-1.88) 0.67	0.91(0.40-2.06) 0.82
Senegal, 2014	1.78(0.91-3.50) 0.09	**2.21(1.10-4.46) 0.03**	1.63(0.81-3.31) 0.17	1.58(0.82-3.03) 0.17	1.82(0.91-3.65) 0.09	1.95(0.96-3.95) 0.06
South Africa, 2016	**1.43(1.04-1.97) 0.03**	**1.62(1.18-2.22) <0.001**	**1.42(1.03-1.96) 0.03**	1.31(0.94-1.81) 0.11	1.33(0.97-1.83) 0.08	**1.47(1.07-2.02) 0.02**
Timor-Leste, 2016	1.21(0.90-1.63) 0.20	**1.50 (1.11-2.02) <0.001**	1.14(0.85-1.53) 0.37	1.07(0.80-1.45) 0.62	1.21(0.90-1.64) 0.20	**1.50(1.10-2.05) 0.01**
Uganda, 2016	1.08(0.96-1.22) 0.19	**1.22(1.08-1.38) <0.001**	1.05(0.92-1.18) 0.48	0.91(0.81-1.03) 0.15	1.03(0.91-1.16) 0.64	1.11(0.98-1.26) 0.09
Yemen, 2013	0.87(0.43-1.77) 0.70	1.07(0.50-2.27) 0.87	0.87(0.42-1.77) 0.69	0.81(0.39-1.67) 0.57	0.88(0.43-1.81) 0.74	1.08(0.51-2.32) 0.84
Colombia, 2015	0.99(0.84-1.15) 0.89	**1.35(1.16-1.57) <0.001**	0.97(0.83-1.13) 0.70	0.89(0.76-1.03) 0.13	0.97(0.83-1.14) 0.73	**1.24(1.06-1.45) 0.01**

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6, S1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6, S2
Bias	9	Describe any efforts to address potential sources of bias	S1, S2
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	S2
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	na
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4-5
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P8, T1
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	T2

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	S3
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	S files
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Adolescent childbirth and mobility disability among women ages 15-49: an analysis of population health surveys from 14 low- and middle-income countries

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TITLE: Adolescent childbirth and mobility disability among women ages 15-49: an analysis of population health surveys from 14 low- and middle-income countries

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ABSTRACT

Objectives: Adolescent childbirth is associated with older adult adverse health outcomes that negatively affect mobility function, but these associations have not been studied globally in large samples of reproductive-age women. This study examines the association between age at first childbirth and mobility disability in national surveys from low- and middle-income countries, and hypothesizes that adolescent childbirth is associated with mobility disability.

Design: Cross sectional analysis

Setting: Population health surveys from 2013-2018 containing mobility disability measures among ever-pregnant women ages 15-49. These included 13 Demographic Health Surveys (DHS) from Haiti, Pakistan, Uganda, Cambodia, Colombia, South Africa, Timor-Leste, Albania, Gambia, Maldives, Peru, Senegal, and Yemen and 1 Maternal Health Survey from Ghana.

Participants: The sample included 157,988 women ages 15 to 49 years.

Primary Outcome Measure: Adolescent childbirth was defined as 10 to 19 years of age. Poisson regression models were used to estimate prevalence ratios (PR) of mobility disability among women who first gave birth during adolescence and in adult life (ages 20 to 45 years) in each country and across the whole sample. Countries were also analyzed according to the use of standard and non-standard mobility disability measures. Covariates included current age, urban/rural residence, education, and household wealth.

Results: Prevalence of adolescent childbirth (17·5%-66·2%) and mobility disability (0·32%-21·45%) varied widely across countries. Adolescent childbirth was significantly ($p<0·05$) associated with greater mobility disability in 6 of 8 countries utilizing standard disability measures. Among the 6 countries that did not use standard disability measures, none showed a statistically significant association between adolescent childbirth and mobility disability. Considering the whole sample and adjusting for all covariates, women who gave birth during adolescence had greater prevalence of mobility disability (Pooled PR 1·19, 95%CI 1·06-1·31).

Conclusions: This analysis suggests a moderate and consistent association of adolescent childbearing with subsequent mobility disability.

Strengths and Limitations of This Study

- A strength of this study is the large sample (>100,000) of reproductive age women from diverse geographic settings across the globe
- The statistical analysis was based on *a priori* hypotheses guided by a strong theoretical framework
- This study compared associations across different ways of measuring mobility disability, providing important measurement insights for assessing disability in large studies
- Data for the outcome variable of mobility disability were self-reported, which may underestimate true prevalence.
- Cross-sectional nature of population health surveys prevent ascertainment of the timing of the onset of the mobility disability

INTRODUCTION

Disability - the inability to perform specific social roles in day-to-day life due to health or physical problems, affects nearly 15% of the global population,[1] with 80% of the burden in low- and middle-income countries (LMIC).[2] While disability is highly prevalent, it is also difficult to measure and frequently underestimated, with limited comparable evidence globally.[1]

Adult-onset disability includes cognitive and mobility limitations, representing the end state of several impairment events leading to functional limitations and difficulties in daily activities.[3,4] Approximately 7% of individuals globally live with mobility disability,[1] a critical marker of wellbeing.[4] Mobility disability is a public health challenge, associated with declines in quality of life, and can contribute to substantial healthcare expenditures.[5] Moreover, mobility disability is associated with premature mortality and frequently results from changes to the immune, nervous, and endocrine systems initiated earlier in life.[5,6]

Mobility disability is well examined in older adults and associated with numerous factors including gender, social position, and medical conditions such as cardiovascular disease and arthritis.[7] Mobility disability is common among middle-aged adults in high-income countries.[7] In low-income settings, prevalence in young adulthood (18-24) can approach that of middle-age and older adults from high-income settings.[8] Limited work examines risk factors for mobility disability specific to younger age groups.[7] In research specifically examining women during mid-life, arthritis and back pain appear to contribute most substantially to disability prevalence, and middle-aged women tend to perform substantially worse on standardized tests of strength and balance and report more difficulties with self-reported measures of mobility disability.[9]

Globally, women tend to have a higher prevalence of mobility disability compared to men, and this is more evident in LMIC.[10,11] Moreover, mobility disability appears to occur at earlier ages for women.[8,12] Thus, there may be unique risk factors for mobility disability in women.

To understand the greater burden of mobility disability among women, studies have demonstrated an association between reproductive history (parity and age at first birth) and outcomes that are highly correlated with mobility disability, including low physical function

measures, [13,14] but these studies have generally adopted smaller, non-representative samples of mostly peri- or postmenopausal women.

An estimated 18.5 million adolescent girls give birth every year in LMIC.[15] While adolescent fertility affects lifelong health[16,17] and has educational and economic[17,18] consequences for women and communities, few studies have sought to examine the relationship between adolescent childbearing and mobility disability.

Although there is evidence of the association between early childbirth and indicators of mobility disability among middle-aged[13] and older women,[14] this association has not been investigated among younger women. Such investigation may provide important data to inform reproductive health policies, while also providing sex-specific insights into mobility disability etiology.

In this study, we use 13 Demographic Health Surveys (DHS) and 1 Maternal Health Survey (Ghana) to study the association between adolescent versus adult childbirth and mobility disability among women of reproductive age (15-49 years) across 14 LMICs. Further, given few comparative studies on disability that include LMIC, and known underestimation of disabilities,[1] we also compare disability estimates, and measures of association, across the 14 countries.

METHODS

Data Sources and Procedures

All publicly-available national Demographic and Health Surveys (DHS), other DHS-related surveys, and Multiple Index Cluster Surveys (MICS) conducted between 2013-2018 were reviewed to identify measures of mobility disability among women of reproductive age.[19] These population-based surveys are considered to have samples representative of the countries in which they are administered. Surveys without disability measures were excluded. If a single country had multiple surveys between 2013 and 2018, only the most recent was analyzed. A total

of 14 country-surveys had information on mobility disability and were included: 13 DHS (rounds VI and VII), and one Maternal Health Survey (Ghana, 2017).

The resulting sample included 157,988 women ages 15 to 49 years, with complete data on their age at first birth from 14 countries. The response rate for mobility disability questions among the sample population was greater than 99% in all surveys.

Measures

Exposure - Adolescent childbirth:

Adolescent childbirth was defined according to UN recommendations, ranging from 10 to 19 years of age.[15] Due to the implausibility of certain responses and to assure comparability across all surveys, we excluded from analysis women whose first childbirth was reported as 9 years or younger or older than 45 years (less than 1% of respondents). Our comparison group, adult childbirth, included those reporting their first birth between 20 and 45 years. The surveys used self-reported 'age of respondent at first birth,' which was measured consistently with standard questionnaires across all countries.

Outcome - Disability:

In 2016, DHS adopted a standard disability module, with mobility disability assessed with a question widely used in observational studies. DHS uses the Washington Group on Disability Statistics validated Short Set on Functioning. It comprises six questions assessing six domains of disability: seeing, hearing, walking/climbing, remembering/concentrating, self-care, and communicating.[1,20] This scale has been used in previous global comparative studies and extensively field tested in a variety of settings.[1] As this analysis focuses on mobility, we examined the question specific to mobility impairment: "I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?"

Across surveys there was considerable diversity in the wording of the questions used to measure mobility disability (see Table S1; appendix A). Some surveys applied the standard disability module verbatim (Haiti, Pakistan, and Uganda). Others used a slightly modified version and/or

were already using a version of the mobility question used in the Short Set on Functioning (Cambodia, Colombia, Ghana, South Africa, and Timor-Leste). We mapped the mobility disability assessment questions used across surveys to the standard module and stratified according to those that used the Short Set on Functioning question (or a similar version) and those using other assessments of mobility disability (see Table S1). We refer to surveys using the mobility disability question from the Short Section on Functioning as applying the standard disability question. Six surveys included unique and highly varied questions on disability and mobility (Albania, Gambia, Maldives, Peru, Senegal, and Yemen). All of these employed dichotomous response options of yes/no for indicating disability. To compare across all surveys, the responses 'some difficulty', 'a lot of difficulty', and 'cannot walk or climb steps at all' were classified as 'mobility disability' for the 8 countries using the standard disability question. We thus utilized a dichotomous mobility disability outcome for every country that was measured similarly for 8 standard surveys and distinctly for 6 non-standard surveys.

Explanatory Variables

Analyses in this study account for the effects of the following covariates: women's age in years at time of the survey, census-based definition of residence (urban/rural), educational attainment (no education, primary, secondary or more), and household wealth in quintiles. Covariates were selected on *a priori* evidence of potential confounding based on a life-course perspective relating adolescent exposures to adulthood health outcomes. Table S2 provides a description of each of these explanatory variables, along with why they were included in the analysis. Figure S1 depicts the hypothesized causal pathways by which adolescent childbirth could impact mobility disability later in life. Based on this figure, and corresponding directed acyclic graph, no statistical adjustment is required to estimate the total effect of adolescent childbirth on mobility disability, while adjustment for age, location of residence, education attainment, and household wealth is needed to estimate the direct effect.[21]

Statistical Analysis

All cross-sectional analyses were conducted using the survey sampling weights provided by the population-based surveys.[17] Descriptive statistics were performed to characterize the primary

exposure and outcome measures. For each country, and for all countries combined, Poisson regression models were fit to estimate crude and adjusted prevalence ratios (PR) of mobility disability among women who first gave birth during adolescence compared to those who first gave birth as adults. All estimates were adjusted for the explanatory variables described above. Marginal predicted probabilities of mobility disability by age (between 15 and 49 years) for adolescent and adult first childbirth were estimated for each country and for all countries combined, applying standard survey weights.

A pooled estimate of the effect (prevalence ratio) was obtained by creating a dataset of adjusted survey estimates and performing a meta-analysis of the 14 surveys, by computing a weighted average of each countries' individual effect estimates. This was done for the full sample and for countries sub-grouped according to the use of the standard mobility question. Heterogeneity was assessed using the I^2 quantity for both the pooled sample of all countries and for the sub-groups. Analyses were conducted using STATA version 16 (STATA, College Station, TX, USA).

RESULTS

There was wide variation in respondent sociodemographic characteristics across surveys (Table 1). The mean age of respondents ranged from 29·6 (SD:10·5) in Colombia to 37·4 (SD:8·0) years in Albania. The percent of respondents living in rural areas ranged from 20·8 in Colombia to 84·7 in Cambodia, while those in the lowest economic quintile ranged from 17·2 in Peru to 21·4 in Yemen. The proportion of respondents who had not received formal education ranged from 1·0% in Albania to 63·7% in Senegal.

Table 1: Sociodemographic characteristics of female respondents who have ever given birth*, by country

Country, year, and survey type	Total ever given birth (n)	First birth between 10 and 19 years (n)	Mean age of respondent at interview, years (sd)	Rural residence (95% CI)	Lowest house-hold wealth quintile (95% CI)	No formal education (95% CI)
Used Standard Disability Question**						
Cambodia, 2014, DHS-VI	11,722	4,053	34.2 (8.2)	84.7% (81.6% - 87.5%)	20.5% (18.1% - 23.2%)	16.3% (14.7% - 18.0%)
Colombia, 2015, DHS-VII	25,446	13,222	29.6 (10.5)	20.8% (19.4% - 22.3%)	20.5% (18.5% - 22.6%)	1.3% (1.1% - 1.5%)
Ghana, 2017, MHS	14,385	7,412	33.5 (8.6)	51.2% (47.5% - 55.0%)	17.6% (15.8% - 19.6%)	28.1% (26.3% - 30.0%)
Haiti, 2016, DHS-VII	8,607	3,816	33.5 (8.5)	57.2% (51.5% - 62.7%)	20.4% (17.6% - 23.5%)	21.1% (19.2% - 23.1%)
Pakistan, 2017-18, DHS-VII	13,118	5,165	33.4 (8.0)	66.4% (61.7% - 70.9%)	19.5% (16.9% - 22.5%)	49.2% (45.9% - 52.4%)
South Africa, 2016, DHS-VII	6,111	2,871	33.6 (8.4)	33.2% (29.1% - 37.5%)	17.5% (15.1% - 20.1%)	2.3% (1.8% - 2.9%)
Timor Leste, 2016, DHS-VII	7,470	2,359	34.1 (8.3)	72.6% (67.2% - 77.5%)	20.4% (18.3% - 22.6%)	29.9% (27.5% - 32.2%)
Uganda, 2016, DHS-VII	13,744	9,197	31.2 (8.5)	75.1% (71.2% - 78.7%)	20.7% (18.6% - 22.9%)	12.3% (11.3% - 13.4%)
Did Not Use Standard Disability Question						
Albania, 2017-18, DHS-VII	7,226	1,316	37.4 (8.0)	42.5% (38.2% - 46.9%)	20.3% (17.4% - 23.3%)	1.0% (0.6% - 1.7%)
Gambia, 2013***, DHS-VI	6,845	4,113	31.2 (8.1)	48.2% (41.1% - 55.4%)	20.3% (17.0% - 24.0%)	60.0% (57.0% - 62.9%)
Maldives, 2016-17, DHS-VII	5,408	1,569	35.1 (7.6)	61.1% (53.8% - 68.0%)	20.1% (17.9% - 22.4%)	6.0% (5.2% - 7.0%)
Peru, 2014***, DHS-VI	17,487	8,237	34.9 (8.4)	26.0% (23.9% - 28.1%)	17.2% (15.9% - 18.7%)	2.9% (2.5% - 3.3%)
Senegal, 2014, DHS-VI	5,733	3,180	32.2 (8.5)	51.1% (41.0% - 61.2%)	20.2% (15.0% - 26.1%)	63.7% (58.2% - 69.0%)
Yemen, 2013, DHS-VI	14,686	8,127	31.8 (8.1)	67.4% (63.2% - 71.5%)	21.4% (19.0% - 23.9%)	55.1% (52.8% - 57.4%)

*For women who had ever given birth who completed the question on mobility disability

**Countries that utilized the disability module developed through collaboration including USAID, Demographic and Health Surveys Program, and the Washington Group on Disability Statistics and/or mapped to this module with very similar questions. See "Demographic and Health Surveys Disability Module, Model Household Questionnaire," https://dhsprogram.com/pubs/pdf/DHSQM/DHS7-Module-Disability-Qnnaire-EN-31Jan2017-DHSQM.pdf.

***These datasets contained a single composite wealth index variable categorized into quintiles using national cut-off points for all areas. In all other countries wealth quintile classification is derived from wealth index scores that use separate cut-off points for rural and urban residences. A wealth variable (V190A) with rural and urban cut-off points was

developed by DHS and included in the databases for Albania, Colombia, Ghana, Haiti, Maldives, Pakistan, Peru, South Africa, Timor-Leste, and Uganda. Our team created the wealth index variable in quintiles for Cambodia, Senegal, Gambia and Yemen from the DHS created cut-off points for urban and rural wealth quintile included in the publicly available datasets.

The prevalence of adolescent childbearing (ages 10-19 years) ranged between 17·5% in Albania in to 66·2% in Uganda (Table 2). In five (Ghana, Uganda, Gambia, Senegal and Yemen) of the 14 countries, more than 50% of women had their first birth at 19 or younger. Mobility disability ranged between 0·3% in Peru to 21·5% in Ghana. Mobility disability prevalence was higher among countries using the standard disability question (range 1·5-21·5%) compared to those using non-standard measures (0·3-1·2%) (Table 2).

Table 2: Prevalence of adolescent childbearing and mobility disability in female respondents who have ever given birth, by country

	Prevalence of adolescent childbearing (10 to 19 years) (95% CI)		Prevalence of first birth between ages 20 and 45 years (95% CI)		Prevalence of mobility disability (95% CI)	
Cambodia, 2014	34.8%	(33.5% - 36.1%)	65.2%	(63.9% - 66.5%)	1.52%	(1.1% - 2.0%)
Colombia, 2015	47.2%	(46.0% - 48.4%)	52.8%	(51.6% - 54.0%)	3.97%	(3.7% - 4.3%)
Ghana, 2017	52.1%	(50.7% - 53.5%)	47.9%	(46.5% - 49.3%)	21.45%	(20.3% - 22.6%)
Haiti, 2016	43.0%	(41.4% - 44.7%)	57.0%	(55.3% - 58.6%)	3.02%	(2.5% - 3.7%)
Pakistan, 2017-18	36.7%	(34.9% - 38.5%)	63.3%	(61.5% - 65.1%)	10.31%	(9.3% - 11.4%)
South Africa, 2016	46.4%	(44.5% - 48.2%)	53.6%	(51.8% - 55.5%)	3.82%	(3.2% - 4.5%)
Timor-Leste, 2016	31.5%	(30.0% - 33.1%)	68.5%	(66.9% - 70.0%)	2.32%	(1.9% - 2.8%)
Uganda, 2016	66.2%	(64.8% - 67.5%)	33.8%	(32.5% - 35.2%)	9.37%	(8.7% - 10.1%)
Albania, 2017-18	17.5%	(16.3% - 18.9%)	82.5%	(81.1% - 83.7%)	0.97%	(0.7% - 1.3%)
Gambia, 2013	58.5%	(56.6% - 60.3%)	41.5%	(39.7% - 43.4%)	1.24%	(0.9% - 1.7%)
Maldives, 2016-17	27.1%	(25.2% - 29.0%)	72.9%	(71.0% - 74.8%)	0.46%	(0.3% - 0.7%)
Peru, 2014	43.2%	(42.0% - 44.5%)	56.8%	(55.5% - 58.0%)	0.32%	(0.2% - 0.5%)
Senegal, 2014	50.1%	(46.4% - 53.8%)	49.9%	(46.2% - 53.6%)	0.60%	(0.4% - 0.9%)
Yemen, 2013	56.1%	(54.8% - 57.4%)	43.9%	(42.6% - 45.2%)	0.45%	(0.3% - 0.6%)

Figure 1 shows the crude and adjusted associations between adolescent childbirth and mobility disability, stratified by use of the standard disability question. Among the eight countries that utilized the standard disability question, the unadjusted PR ranged between 0·99 (95% CI:0·84-1·15) in Colombia and 1·43 (95% CI:1·04-1·97) in South Africa and the adjusted PR ranged from 1·11 (95% CI:0·98-1·26) in Uganda to 1·50 (95% CI:1·10-2·05) in Timor Leste. Adolescent

childbirth was associated with greater mobility disability in three of the eight countries before adjustment, and in six of the eight countries after adjustment. Among the six countries that did not use the standard mobility disability question, no association between adolescent childbirth and mobility disability was observed. Table S3 provides the crude and adjusted PRs by country.

Figure 1: Unadjusted (black diamonds) and adjusted (blue squares) associations between adolescent childbirth and mobility disability, stratified by use of Standard Disability Question in 14 countries

Note: for each country, the first row indicates the crude PR, and the second row indicates the adjusted PR.

Based on the pooled adjusted estimate for all 14 countries, women who gave birth during adolescence had an increased prevalence of mobility disability (Overall PR 1·19, 95%CI:1·06-1·31) compared to women who first gave birth between 20 and 45 (Figure 1). The pooled PR for countries using the standard question was 1·25 (95%CI 1·16-1·34), compared to 1·10 (95%CI 0·83-1·37) for countries using non-standard questions. Results indicate low heterogeneity, i.e., variability not attributable to chance, when examining all countries together (I^2 = 15·0%, p=0·24). There was, however, evidence of moderate heterogeneity based on the sub-group analysis, specifically for the countries that used the standard mobility questions (I^2 =59%, p=0·001). Nevertheless, the effect estimates were consistent across studies using the standard disability question (i.e., indicated by the positive associations) and confidence intervals were relatively narrow.

Figure 2 shows the predicted prevalence of mobility disability by age at time of interview for women who had a first birth during adolescence compared to adulthood. Estimates are based on the marginal prediction of mobility disability by age from the adjusted Poisson regression models including all eight countries that used the standard disability question. Across all ages, prevalence of mobility disability was higher for women who had their first birth during adolescence compared to those who had their first birth later, with an increasing gap between both groups with increasing age. Combined results for all 14 countries showed similar trends (see Figure S2). Figure S3 provides the results for the countries that used non-standard measures of mobility disability.

Figure 2: Pooled prevalence (marginal predictions) of mobility disability comparing women with first birth during adolescence and first birth in adulthood based on countries that used standard Disability Question (n=8).

The supplementary files (Figures S4 and S5) also show the predicted prevalence of mobility disability by adolescent versus adult first childbirth by each country, stratified by those using the standard disability question (Figure S4) versus other measures of mobility disability (Figure S5).

DISCUSSION

Summary of Results

Both the prevalence of adolescent childbirth and mobility disability varied widely across countries. Adolescent childbirth was consistently and significantly associated with greater mobility disability in six of the eight countries that utilized the standard disability question. In the pooled analysis of the 14 countries, women who had their first birth during adolescence continued to have significantly higher prevalence of mobility disability throughout life compared to women who had their first birth as adults.

Comparison with Existing Studies

To our knowledge, no study has been conducted examining the relationship between adolescent childbearing and mobility disability using reproductive age samples or nationally representative surveys of parous women. The focus on mobility disability was based on previous work demonstrating associations between early childbirth and loss of physical performance, as measured by objective tests of lower limb function,[13,14] as well as between early childbirth and cardiometabolic disease.[22,23] Physical performance tests assess functional limitations that contribute significantly to mobility disability.[5] Cardiometabolic diseases contribute to loss of physical function, slower walking speeds and to mobility disability. [24–29] Thus, previously observed associations between early childbirth and predictors of mobility disability provided evidence supportive a relationship between early childbirth and mobility disability, which was examined by this study.

Our data presents an overview of LMICs from diverse global regions. The percentage of women who first gave birth between ages 10 and 19 years was lowest in Albania and highest in Uganda, which generally ascribed to what is known about the relative regional prevalence of childbearing.[30] While rates of adolescent childbirth among those who have given birth in several African countries were higher than current estimates suggest,[30] the adolescent pregnancy rate has declined over time across most regions, so the prevalence for women born in earlier cohorts (currently in their later reproductive years) is higher than the prevalence in more recent cohorts.[31]

The measurement of mobility disability has historically been challenging and remains relatively understudied in LMIC.[2] Variability in the prevalence of mobility disability was previously documented in the 59 countries included in the 2004 WHO World Health Survey, where the average disability prevalence was 15·6%, ranging from 11·8% in high-income countries to 18·0% in low-income countries.[1] Generally, countries that report low prevalence of disability use measures that focus on a narrow range of impairments, while countries with higher disability prevalence tend to collect data with surveys often containing more comprehensive measures.[1] More recent comparative global studies are largely lacking and our findings underscore previous calls for harmonization of disability surveys for comparative purposes. [1]

To quantify the health burden associated with adolescent fertility, others studies have examined years of healthy life lost due to adverse pregnancy and childbirth outcomes.[32] While, to our knowledge, no one has studied adolescent childbearing and mobility disability using large datasets, previous associations with years of healthy life lost hint at the possibility of an association between adolescent childbirth and adult-onset disability. Adolescent mothers are prone to adverse pregnancy and childbirth events that affect quality of life.[15,32] Complications related to pregnancy and childbirth are a leading cause of death and disability (including anemia, incontinence, damage to the reproductive system, chronic pain, and infertility) among women of reproductive age in low-income countries.[33] However, studies tend to focus on the direct health effects of obstetric complications, which are not the only factors that could contribute to mobility disability. A recent systematic review of adolescent childbearing and cardiovascular disease (CVD) suggested the former as an important cause of disability, especially with advancing age.[16] Similarly, obesity may be on the pathway between adolescent childbirth and

mobility disability[13] and associations between adolescent childbirth and obesity have been documented.[34,35]

Interpretation of Findings

Overall, our results provide important evidence of a population-wide association between adolescent childbearing and mobility disability. Of interest is that the eight countries that utilized the standard disability question produced much more precise estimates of both prevalence of disability and its association with adolescent pregnancy, and had generally larger effect sizes than the countries using other questions.

For the six countries that used non-standard questions, the estimates were less precise, and associations with adolescent childbirth were unobserved. The prevalence of mobility disability was also consistently lower than would be expected based on the most recent available WHO estimates of disability.[1] Two surveys, Albania and Maldives, asked respondents to directly identify what long-term disability they have. This highlights the importance of using standardized, validated measures of disability. It is assumed that the validated disability module would provide higher quality data, as the questions ask whether people can perform activities of daily living, as opposed to asking individuals to self-identify as disabled, which is a potentially stigmatizing label. The Washington Disability Group (2017) explicitly advises against using the word disability in questionnaires or interviews to avoid casting the questions in a negative light and due to the variability about how a term is understood between and within populations. Non-standardized and non-validated questions also allow for a variety of interpretations related to self-perceptions of physical ability, that can compromise data on the true prevalence of disability.

While mobility disability is often a condition associated with aging, our results suggest that mobility declines are emerging in early to middle adulthood for some women. The fact that this observation was relatively consistent across different countries indicates that this phenomenon is not context-specific.

Our results are also suggestive of earlier initiation of the disablement process among women who first gave birth during adolescence. These women will likely live longer with mobility problems,

which may negatively impact their quality of life and increase individual and government health-related costs. It is also well recognized that disability, especially in LMIC, contributes to premature mortality.[6] Given research to indicate reduced longevity for adolescent mothers,[36,37] our findings of an association with mobility disability may point to one mechanism underlying premature mortality for adolescent mothers.

Mobility disability may emerge as an amplified physical manifestation of the socio-economic disadvantages that may precede and/or be accelerated by adolescent childbirth. As depicted in Figure S1, early childbirth may initiate a cascade of social and biological changes that impact health over the lifespan. These may stem from physical injury resulting from the birth process as an adolescent. Adolescents tend to experience more obstetrical complications, including anemia, fistula and complications from unsafe abortion.[33] Moreover, a higher number of pregnancies, and/or mistimed or insufficiently spaced pregnancies may be more likely when childbearing happens earlier.[15,32] These may directly contribute to mobility disability through pathways such as obesity. Both multiparity and short interpregnancy intervals are associated with obesity,[38,39] with obesity being an important risk factor for mobility disability, especially in women.[40]

Adolescent childbirth is associated with lower educational attainment [41–43] and lower lifetime earnings.[43] Both are risk factors for mobility disability.[44–46] In our analyses, we statistically adjusted for measures of education and wealth. Surprisingly, these adjustments led to higher prevalence ratios in all countries except the Maldives. If the association between adolescent fertility and mobility disability was due to education and wealth, it should have attenuated, not strengthened. This suggests other pathways may link early childbearing to mobility loss.

Methodological Considerations

All our estimates are based on self-reported data, and perceptions of disability are context dependent. Self-reported rates of disability are often lower than those estimated through objective measures of function, such as grip strength, walking speed, or time needed to rise from

a chair.[47] Thus, mobility disability is likely underestimated among respondents in these surveys, especially in countries using non-validated measures of mobility disability.

The DHS provides novel opportunities for comparative analysis of disability across diverse contexts, including in low-resource countries where other sources of information regarding disability are unavailable. Because of the wide range of questions asked of DHS respondents, we could adjust for a number of explanatory variables identified in literature as potential confounders in the relationship between age of childbirth and mobility disability: age,[48] location of residence,[49] education,[41,50,50] and wealth quintile.[50–52] This is a strength of our analyses.

As DHS surveys are cross-sectional, we cannot know conclusively whether the disabilities reported were present at birth, developed during infancy or childhood, or were adult-onset. Thus, it is possible that for some women, mobility disability contributed to adolescent pregnancy.[53] Generally, and in contrast to other forms of disability, such as developmental disability, mobility disability arises in middle age and older adulthood [7] and thus, the numbers of women with mobility disability during adolescence is likely small. While there is very limited global literature on mobility disability in childhood and adolescence, a recent study in the United States using the question, “Do you have serious difficulty walking or climbing a flight of stairs” estimated that less than 3% of those under 18, in the state of Oregon, had mobility disability. While clearly more research on mobility disability in youth is needed, it is unlikely that the associations observed here are attributable to mobility disability resulting in adolescent pregnancy.

The surveys also have limitations around the reproductive and social history information that could be relevant to the analysis. Data on adolescent pregnancies that did not end in a live birth were not collected, which may correspond to many pregnancies among adolescents.[54] Past experiences of childhood violence were also not consistently measured across the data sets and may represent a confounder that was unaccounted for in our analysis. Parity was not included in the analysis as it is on the causal pathway between adolescent childbirth and disability; women who begin their childbearing years earlier tend to have more children.[13] Therefore, adjusting for parity leads to an overadjustment obscuring real associations. Finally, as this analysis only

included parous women, our findings may not be generalizable to women who did not or could not give birth.

CONCLUSION

Results from this study of reproductive-age women across diverse global contexts is concordant with previous research in higher income settings and in older populations. The results provide new evidence of the long-term disabilities associated with adolescent childbirth in LMICs. Our results also suggest that the negative effects of adolescent childbearing may have their onset in early to middle adulthood instead of only later in life.

These findings reinforce the need for preventive health policies targeting the critical period of adolescence, including availability of sexual and reproductive health education and access to services and contraceptives, as well as health and social supports for adolescent mothers, with the goal of maintaining health across the life course. These policies need to be inclusive of adolescents and adults with disabilities.

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COMPETING INTERESTS

The authors declare no competing interests.

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DATA SHARING

Data and data dictionary are publicly available by request at https://dhsprogram.com/. Statistical code can be provided upon request to the corresponding author.

CONTRIBUTORS

KEP, DGB, and CMP: conceptualized the study, developed the analytical strategy, did the statistical analysis, interpreted the results, and wrote the first draft of the report.
SMAC and MPV contributed to the study conceptualization and analytical framework.
SMAC, MRD, TLS, and MPV: contributed to the interpretation of the results and did the critical revisions. KEP, DGB, and CMP: verified the underlying data.

PATIENT AND PUBLIC INVOLVEMENT

This paper analyzes existing, public data from population surveys conducted from 2013-2018. No patients were involved, as this is secondary data analysis and the surveys did not involve people receiving clinical care. The public was not involved in the design or conduct of the study. If published, we intend to disseminate widely to reach a broad audience.

ETHICS STATEMENT

This research consisted of a secondary data analysis of a public dataset in which respondents were not individually identifiable. Analysis does not involve research with human subjects and did not require review by an ethics committee/Institutional Review Board.

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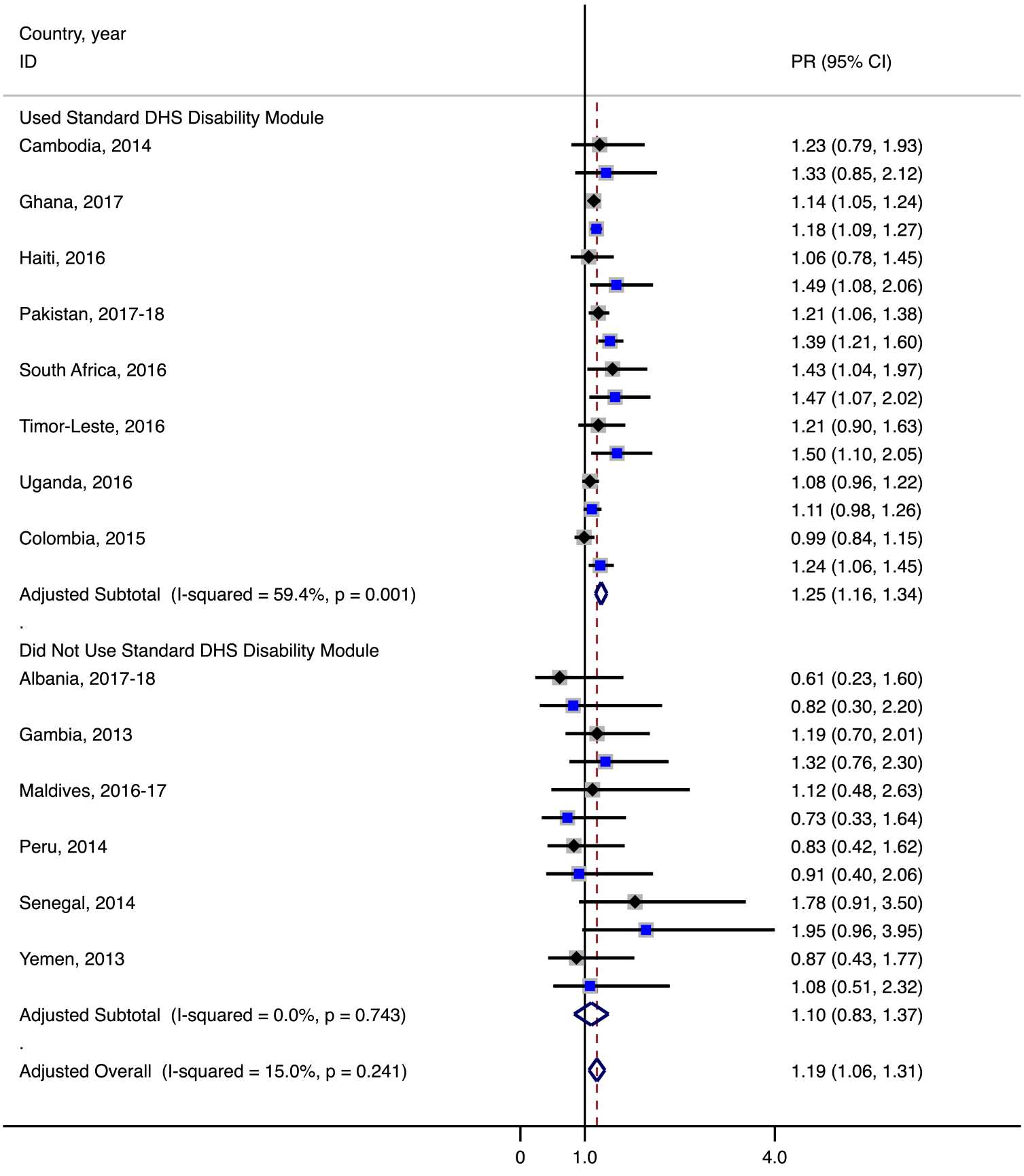
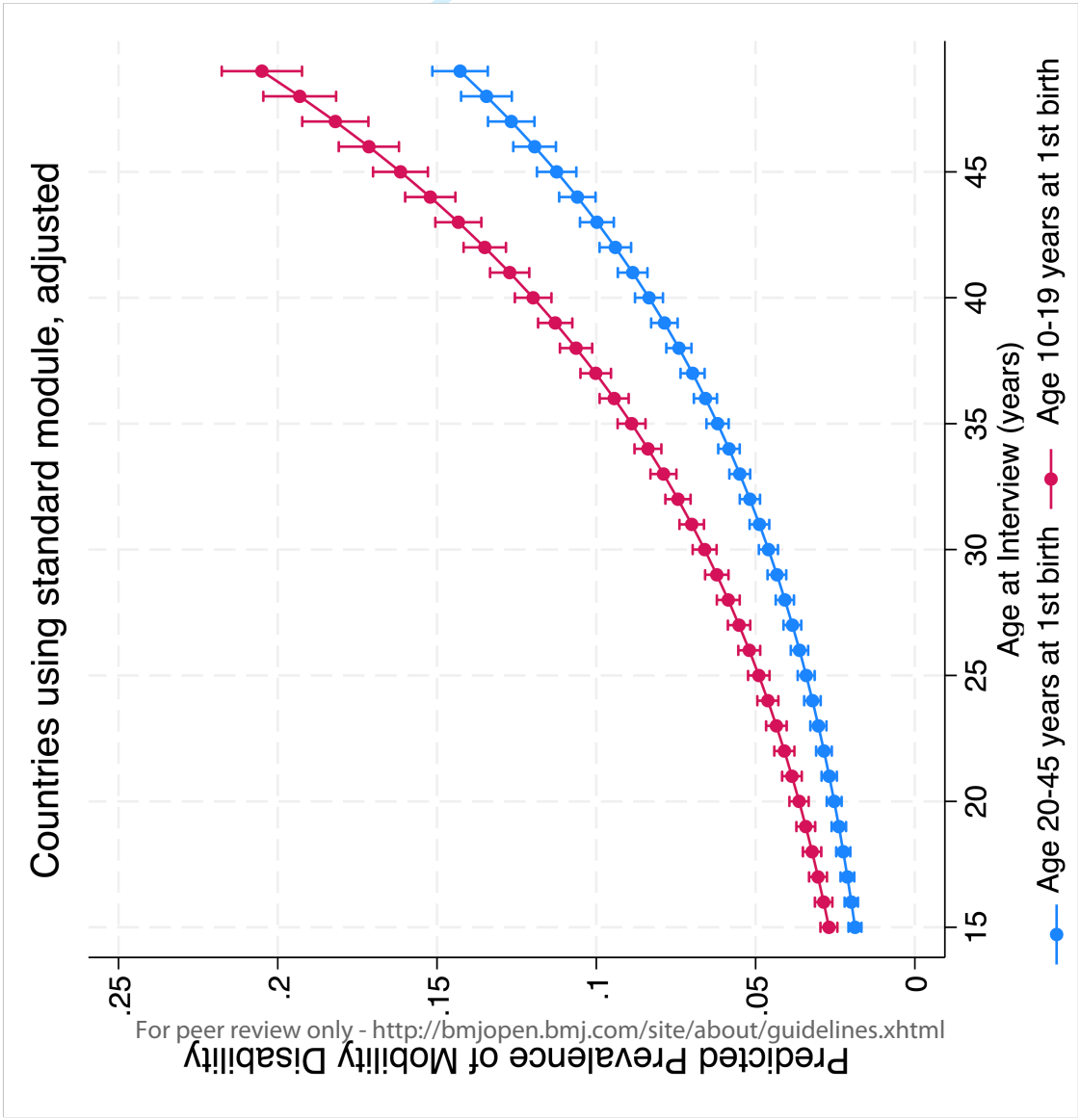

Country, year
ID
PR (95% CI)
Used Standard DHS Disability Module
Cambodia, 2014
1.23 (0.79, 1.93)
1.33 (0.85, 2.12)
Ghana, 2017
1.14 (1.05, 1.24)
1.18 (1.09, 1.27)
Haiti, 2016
1.06 (0.78, 1.45)
1.49 (1.08, 2.06)
Pakistan, 2017-18
1.21 (1.06, 1.38)
1.39 (1.21, 1.60)
South Africa, 2016
1.43 (1.04, 1.97)
1.47 (1.07, 2.02)
Timor-Leste, 2016
1.21 (0.90, 1.63)
1.50 (1.10, 2.05)
Uganda, 2016
1.08 (0.96, 1.22)
1.11 (0.98, 1.26)
Colombia, 2015
0.99 (0.84, 1.15)
1.24 (1.06, 1.45)
Adjusted Subtotal (I-squared = 59.4%, p = 0.001)
1.25 (1.16, 1.34)
.
Did Not Use Standard DHS Disability Module
Albania, 2017-18
0.61 (0.23, 1.60)
0.82 (0.30, 2.20)
Gambia, 2013
1.19 (0.70, 2.01)
1.32 (0.76, 2.30)
Maldives, 2016-17
1.12 (0.48, 2.63)
0.73 (0.33, 1.64)
Peru, 2014
0.83 (0.42, 1.62)
0.91 (0.40, 2.06)
Senegal, 2014
1.78 (0.91, 3.50)
1.95 (0.96, 3.95)
Yemen, 2013
0.87 (0.43, 1.77)
1.08 (0.51, 2.32)
Adjusted Subtotal (I-squared = 0.0%, p = 0.743)
1.10 (0.83, 1.37)
.
Adjusted Overall (I-squared = 15.0%, p = 0.241)
1.19 (1.06, 1.31)
0
1.0
4.0



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

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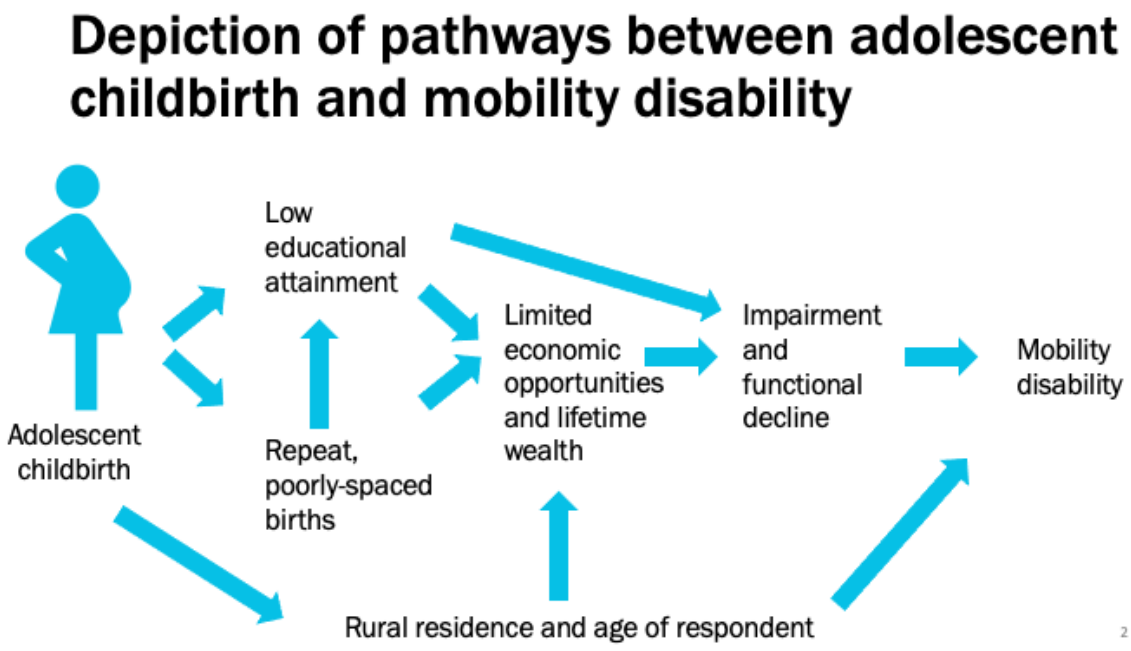
Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

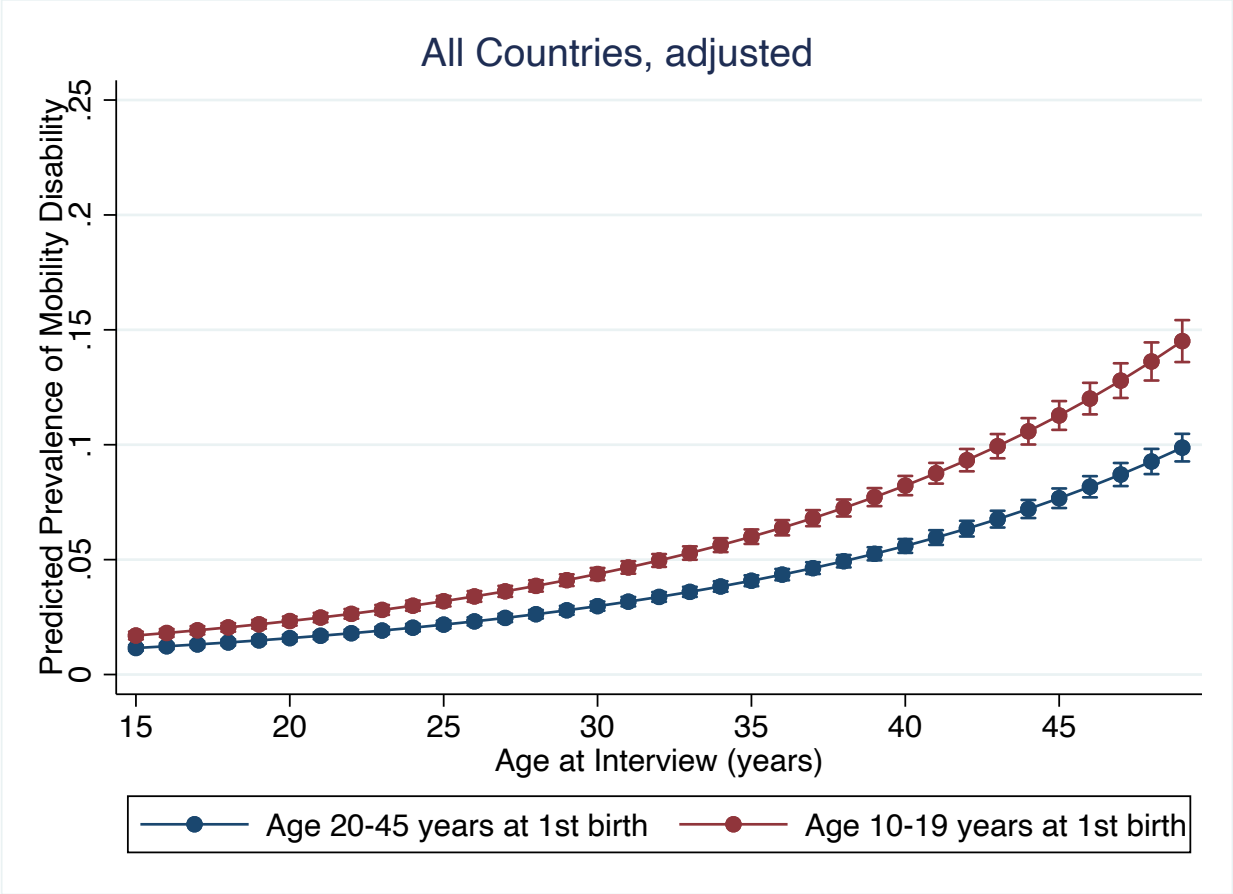
Figures S1: Hypothesized Causal Pathways



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Figure S2: Pooled prevalence (marginal predictions) of mobility disability comparing women with first childbirth during adolescence and first birth in adulthood based in all countries (n=14).

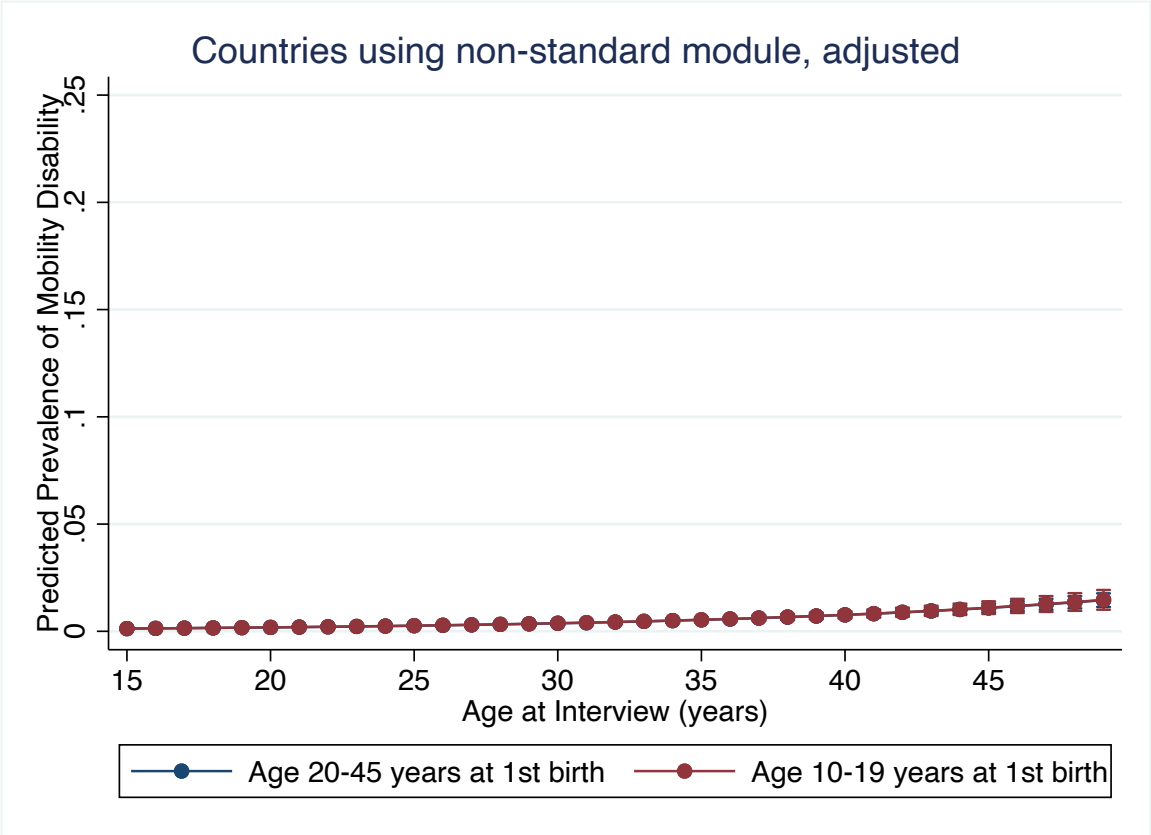
Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Figure S3: Pooled prevalence (marginal predictions) of mobility disability comparing women with first childbirth during adolescence and first birth in adulthood based on countries that used non-standard measures (n=6).

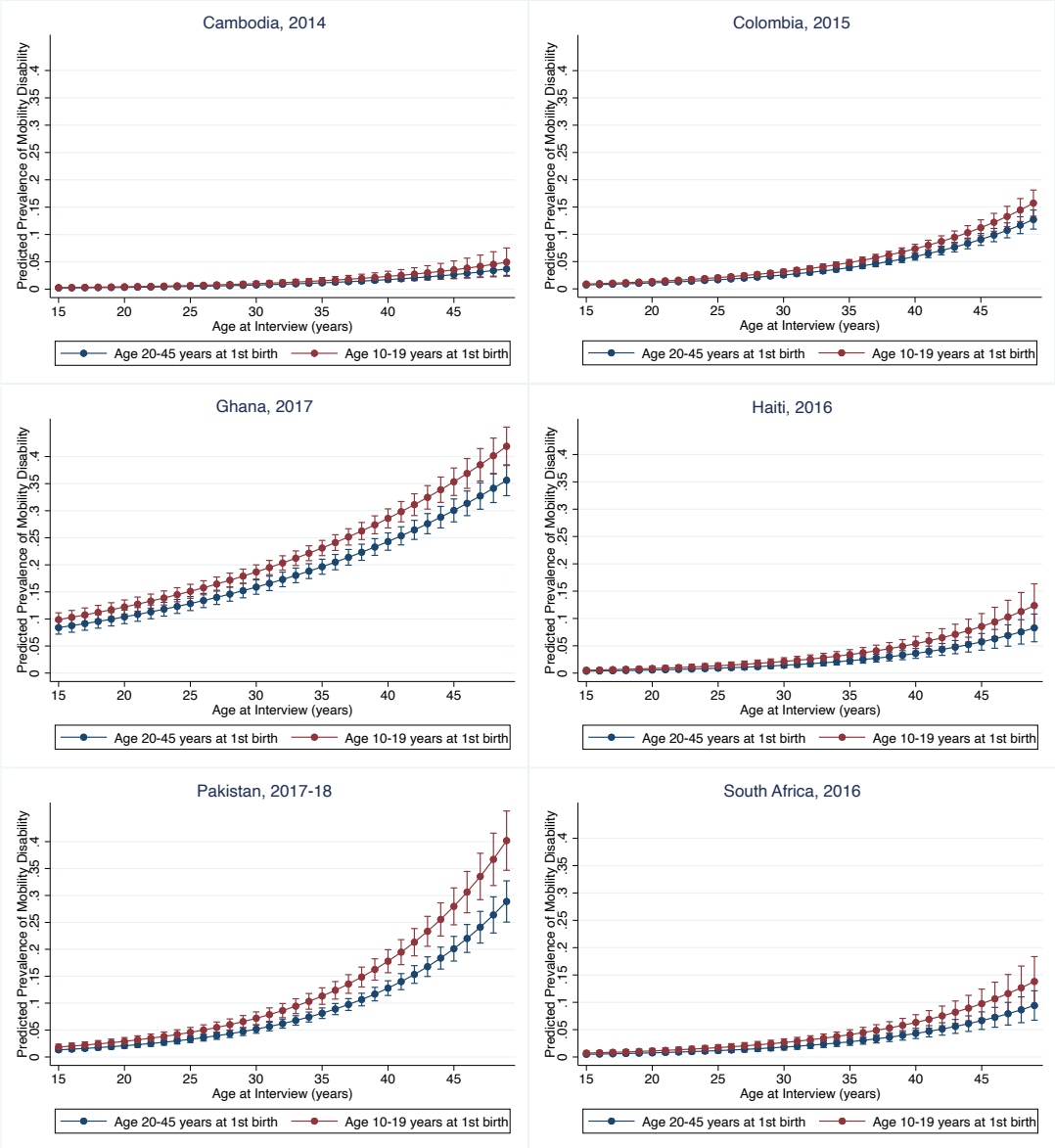
Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Figure S4: Predicted prevalence of mobility disability comparing women with first childbirth during adolescence and first childbirth in adulthood, by country, among those using the standard disability question.

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

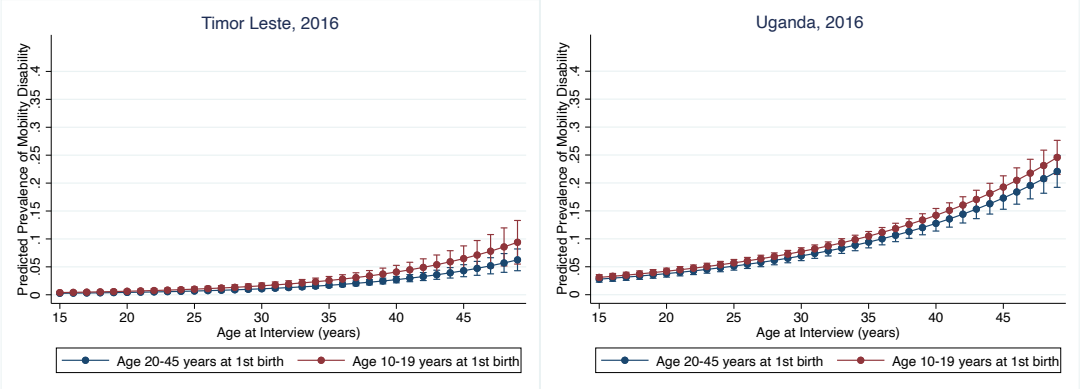


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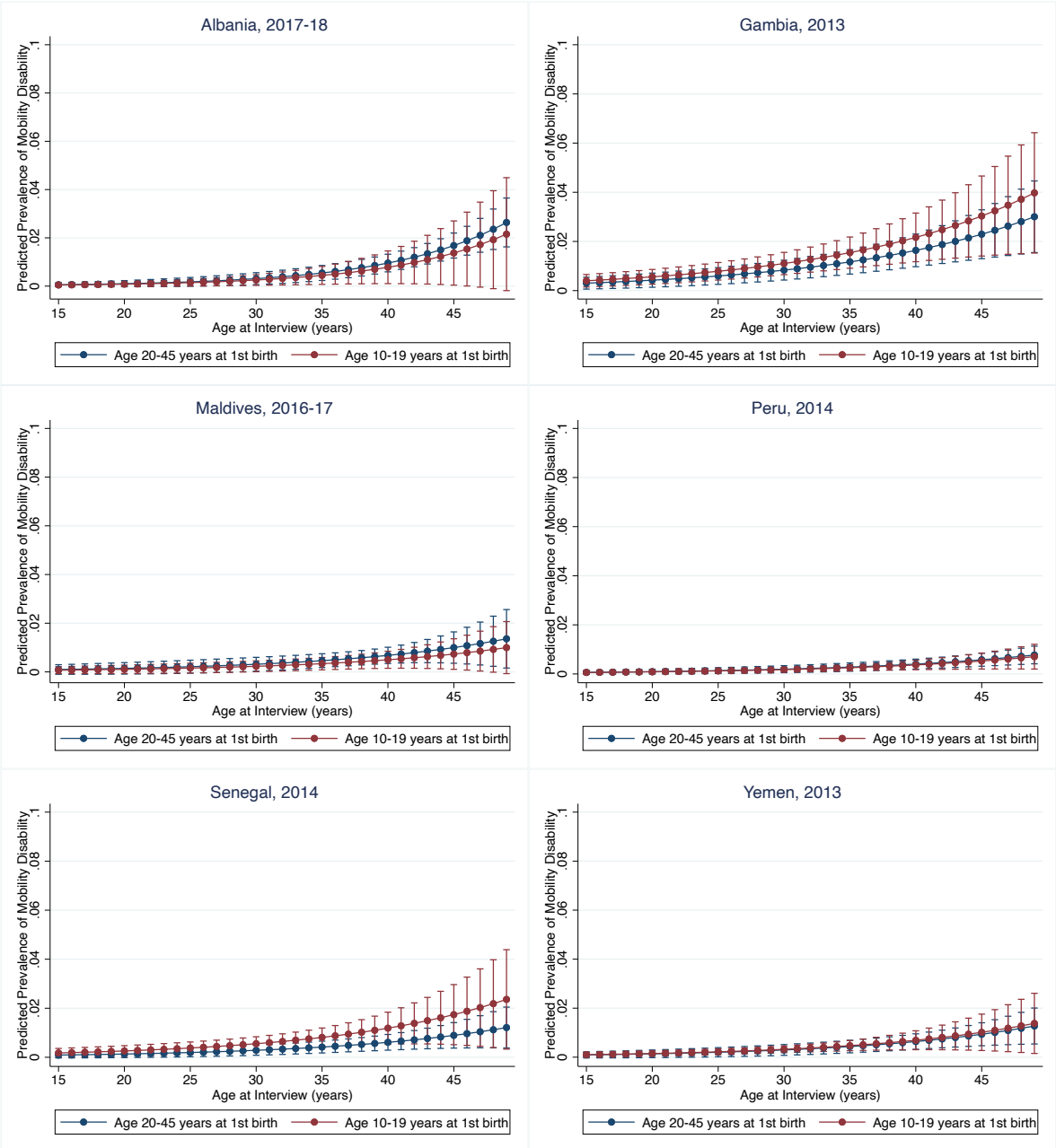
Figure S5: Predicted prevalence of mobility disability comparing women with first childbirth during adolescence and first childbirth in adulthood, by country, among those using non-standard disability measures

Note: estimates are adjusted for age at interview, rural/urban residence, educational attainment, and wealth quintile.



Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Table S1: Mobility disability questions and response options for the countries included in the analysis.

Country	Question	Response Options Indicating Mobility Disability
Countries/surveys Using the Short Set on Functioning Disability Mobility Question		
Cambodia, 2014	23: Does [NAME] have difficulty walking or climbing steps?	2=With some difficulty 3=With a lot of difficulty 4=Cannot walk or climb stairs at all
Colombia, 2015	53. The following questions are about the ability of people to perform daily activities, without help or assistance. Would you say given their physical and mental condition, can [NAME] move their body, walk, or go up or down stairs?	1=Cannot do it 2=Can do it with a lot of difficulty 3=Can do it with some difficulty
Ghana, 2017	923: I would like to know if you have difficulty walking or climbing steps. Would you say that you have no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulty 3=A lot of difficulty 4=Cannot at all
Haiti, 2016	34: I would like to know if (name) has difficulty walking or climbing steps. Would you say that (name) have no difficulty walking or climbing steps, some difficulties, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulties 3=A lot of difficulties 4=Cannot walk or climb at all
Pakistan, 2017-18	33: I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=Some difficulty 3=A lot of difficulty 4=Cannot walk or climb at all
South Africa, 2016	22: Does (NAME) have difficulty walking a kilometre or climbing a flight of steps? IF YES, PROBE: With some difficulty, with a lot of difficulty, or cannot walk or climb steps at all?	1=With some difficulty 2=With a lot of difficulty 3=Cannot walk or climb at all

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Timor-Leste, 2016	27: Does (NAME) have any difficulty walking or climbing steps?	2=Some difficulty 3=A lot of difficulty 4=Can't walk at all
Uganda, 2016	31: I would like to know if (NAME) has difficulty walking or climbing steps. Would you say that (NAME) has no difficulty walking or climbing steps, some difficulty, a lot of difficulty, or cannot walk or climb steps at all?	2=With some difficulty 3=With a lot of difficulty 4=Cannot walk or climb at all
Countries/surveys Not Using Alternative Mobility Disability Questions		
Albania, 2017-18	1106: What type of chronic disability do you have?	D=Mobility problems
Gambia, 2013	27: Does (NAME) have any difficulty using his / her legs even for simple activities such as walking or climbing up the stairs?	1=Yes
Maldives, 2016-17	27: What type of disability does (NAME) have?	07=Medical disability
Peru, 2014	26: Does (NAME) have any limitation or permanent disability?	1=To move around, walk, using arms or legs
Senegal, 2014	31: Does (NAME) have a reduction or weakness in the following functions: CIRCLE ALL THE MENTIONED FUNCTIONS A=SIGHT B=HEARING C= COMPREHENSION & COMMUNICATION D=MOBILITY E=SELF-CARE F=INTERACTION WITH PEOPLE 32: WHAT IS THE PRINCIPAL CAUSE OF THE DISABILITY OF (NAME)?	D=Mobility
Yemen, 2013	32: Does (NAME) face limitations of any of the following: A = SIGHT? B = HEARING? C = COMPREHENSION & COMMUNICATION? D = MOBILITY? E = SELF-CARE? F = DEALING WITH PEOPLE?	D=Mobility

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Table S2: Explanatory Variables of Relevance to the Analysis

Variable	DHS Measure	Potential for Confounding	Consistently Measured Across DHS?
Age	All surveys asked respondents their month and year of birth, as well as their age at their last birthday. In cases of discrepancy, survey administrators were encouraged to correct the inconsistencies. Age was reported in years.	Chronological age and disability are positively associated.[1]	Yes
Location of Residence	Across the surveys, residence was consistently recorded as urban or rural.	Disability is reported at higher rates in rural than urban settings.[2] Location of residence also relates to other factors of interest, such as education and wealth.	Yes
Education	12 of the 14 surveys asked respondents to report their highest year of schooling as none, primary, secondary, or higher, while 2 of the 14 surveys (Ghana and Yemen) contained unique response options.	Educational attainment is consistently and negatively associated with mobility disability, especially with increasing chronological age.[3,4] It is also negatively associated with adolescent childbirth.[5]	To harmonize across surveys, educational attainment was re-coded across the countries as none, primary, or secondary or higher.
Wealth Quintile	All surveys collected standardized information on a respondent's household assets. DHS utilizes a standardized recoding of these assets across surveys in order to create the wealth index, a composite measure of a respondent's household standard of living (ICF, 2018). The wealth index is then separated into quintiles, with Q1 representing the poorest 20 percent of householders and Q5 the richest 20 percent of households.	Economic factors, including limited income, are associated with frailty among older adults.[3,4,6] It has also been established that there is a strong correlation between poverty and disability in LMICs.[7]	For purposes of harmonizing the datasets, we coded a wealth index variable in quintiles from the DHS-created cut-off points for urban and rural wealth quintile included in the publicly available datasets.

Adolescent Childbirth Associated with Mobility Disability Among Women Ages 15-49: an Analysis of Population Health Surveys from 14 Low- and Middle-Income Countries

Table S3: Crude and adjusted associations between adolescent childbirth and mobility disability, by country

Note: Bold font indicates statistically significant associations at a p-value of 0.05 or less. *PR between adolescent childbirth and mobility disability, obtained in separate Poisson regression models. Each (except crude, shown in the first column, and the full adjusted, shown in the last column) is adjusted only for the variable in the corresponding column.

	Crude PR (95% CI) p-value	Adjusted PR (95% CI)* p-value				
		Age	Residence	Education	Wealth Quintile	**All co-variates**
Albania, 2017-18	0.61(0.23-1.60) 0.31	0.84(0.31-2.29) 0.74	0.60(0.23-1.57) 0.29	0.57(0.22-1.48) 0.25	0.57(0.22-1.51) 0.26	0.82(0.30-2.20) 0.69
Cambodia, 2014	1.23(0.79-1.93) 0.36	1.36(0.87-2.13) 0.18	1.22(0.78-1.90) 0.38	1.19(0.76-1.89) 0.45	1.23(0.78-1.95) 0.37	1.33(0.84-2.12) 0.23
Gambia, 2013	1.19(0.70-2.01) 0.53	1.25(0.73-2.14) 0.41	1.23(0.72-2.11) 0.45	1.17(0.68-2.00) 0.57	1.22(0.72-2.10) 0.46	1.32(0.76-2.30) 0.32
Ghana, 2017	**1.14(1.05-1.24) 0.00**	**1.23(1.14-1.33) <0.001**	**1.13(1.05-1.23) <0.001**	**1.09(1.01-1.18) 0.04**	**1.11(1.02-1.20) 0.01**	**1.18(1.09-1.27) <0.001**
Haiti, 2016	1.06(0.78-1.45) 0.70	1.34(0.99-1.82) 0.06	1.09(0.79-1.51) 0.58	1.03(0.75-1.44) 0.84	1.07(0.79-1.45) 0.66	**1.49(1.08-2.06) 0.02**
Maldives, 2016-17	1.12(0.48-2.63) 0.79	0.83(0.37-1.85) 0.64	1.05(0.46-2.39) 0.90	0.81(0.37-1.79) 0.60	0.96(0.40-2.36) 0.94	0.73(0.33-1.64) 0.45
Pakistan, 2017-18	**1.21(1.06-1.38) 0.01**	**1.37(1.19-1.57) <0.001**	**1.24(1.08-1.41) <0.001**	1.14(1.00-1.31) 0.06	**1.21(1.05-1.39) 0.01**	**1.39(1.21-1.60) <0.001**
Peru, 2014	0.83(0.42-1.62) 0.59	1.01(0.50-2.04) 0.98	0.85(0.44-1.67) 0.65	0.73(0.36-1.47) 0.37	0.84(0.37-1.88) 0.67	0.91(0.40-2.06) 0.82
Senegal, 2014	1.78(0.91-3.50) 0.09	**2.21(1.10-4.46) 0.03**	1.63(0.81-3.31) 0.17	1.58(0.82-3.03) 0.17	1.82(0.91-3.65) 0.09	1.95(0.96-3.95) 0.06
South Africa, 2016	**1.43(1.04-1.97) 0.03**	**1.62(1.18-2.22) <0.001**	**1.42(1.03-1.96) 0.03**	1.31(0.94-1.81) 0.11	1.33(0.97-1.83) 0.08	**1.47(1.07-2.02) 0.02**
Timor-Leste, 2016	1.21(0.90-1.63) 0.20	**1.50 (1.11-2.02) <0.001**	1.14(0.85-1.53) 0.37	1.07(0.80-1.45) 0.62	1.21(0.90-1.64) 0.20	**1.50(1.10-2.05) 0.01**
Uganda, 2016	1.08(0.96-1.22) 0.19	**1.22(1.08-1.38) <0.001**	1.05(0.92-1.18) 0.48	0.91(0.81-1.03) 0.15	1.03(0.91-1.16) 0.64	1.11(0.98-1.26) 0.09
Yemen, 2013	0.87(0.43-1.77) 0.70	1.07(0.50-2.27) 0.87	0.87(0.42-1.77) 0.69	0.81(0.39-1.67) 0.57	0.88(0.43-1.81) 0.74	1.08(0.51-2.32) 0.84
Colombia, 2015	0.99(0.84-1.15) 0.89	**1.35(1.16-1.57) <0.001**	0.97(0.83-1.13) 0.70	0.89(0.76-1.03) 0.13	0.97(0.83-1.14) 0.73	**1.24(1.06-1.45) 0.01**

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3. Hoogendijk EO, Rijnhart JJM, Kowal P, et al. Socioeconomic inequalities in frailty among older adults in six low- and middle-income countries: Results from the WHO Study on global AGEing and adult health (SAGE). *Maturitas* 2018; **115**: 56-63.
4. Szanton SL, Seplaki CL, Thorpe RJ, Jr., Allen JK, Fried LP. Socioeconomic status is associated with frailty: the Women's Health and Aging Studies. *J Epidemiol Community Health* 2010; **64**(1): 63-7.
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7. Banks LM, Kuper H, Polack S. Poverty and disability in low- and middle-income countries: A systematic review. *PLoS One* 2017; **12**(12): e0189996.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6, S1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6, S2
Bias	9	Describe any efforts to address potential sources of bias	S1, S2
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	S2
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	na
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4-5
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P8, T1
		(b) Indicate number of participants with missing data for each variable of interest	na
Outcome data	15*	Report numbers of outcome events or summary measures	T2

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	S3
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	S files
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.